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THE ROENTGENOLOGIC ASPECTS OF ACTINOMYCOSIS OF THE LUNGS*

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IT is often difficult clinically to distinguish actinomycosis from other chronic diseases of the thorax, and many cases are recorded in which the disease was wrongly diagnosed for months or years, and finally necropsy revealed its nature. It seems to be most difficult to rule out chronic empyema and tuberculosis. Fistulas, especially when multiple, or hard infiltration of the wall of the thorax in connection with pulmonary symptoms, should be suspected of being of actinomycotic origin; the secretion of such fistulas, the pus from empyematous cavities with marked infiltration of the thoracic wall, and the sputum, should be examined for the organism. Unfortunately, it is not always easy to demonstrate actinomyces and repeated examinations may be necessary. With these considerable difficulties in diagnosis it is easily understood that even in the earlier period of roentgen diagnosis roentgenoscopy and roentgenograms were used to help in the distinction from other diseases.

A review of the literature was undertaken because there seemed to be so few complete data pertaining to this subject. All cases reviewed were proved to be actinomycosis by demonstration of the specific organism during life or at necropsy. Otten, in 1910, reported a case of actinomycotic invasion of the thorax which was represented by bilateral large irregular mediastinal shadows and pulmonary infiltration. A similar case was mentioned by Weber in 1911; both hilums were infiltrated by dense masses which radiated into the lungs giving the appearance of a carcinomatous infiltration. Karewski reviewed the subject in 1914 from a surgical standpoint and pointed out that actinomycotic lesions usually produce dense shadows, often quite circumscribed. He stated that the roentgenologic manifestations were not pathognomonic and often were unreliable. Staub-Oetiker noted 5 cases which had been clinically diagnosed as tuberculosis, and he attributed only a negative value to the roentgen examination inasmuch as it merely excluded a tuberculous lesion. He noted in 2 of his 5 cases either destruction or periosteal thickening of one or more ribs which he had never seen in tuberculosis. Wessler and Jaches described 3 cases of actinomycosis. They stated that the roentgenologic data are not characteristic but represent indurative pleuropneumonia such as may be found in other forms of pulmonary suppuration. However, such an appearance with clinical signs of infiltration of the wall of the thorax should lead to the diagnosis of actinomycosis. Bigland and Sergeant, in 1923, observed a case of actinomycosis in which there was a dense shadow in the lower left part of the thorax with fluid in the pleural and pericardial cavities. The difficulty of distinction between chronic tuberculosis and actinomycosis was emphasized by

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Besser who found in 1 case parenchymatous involvement of the right lung and hilum with an abscess, pleuritic adhesions, and

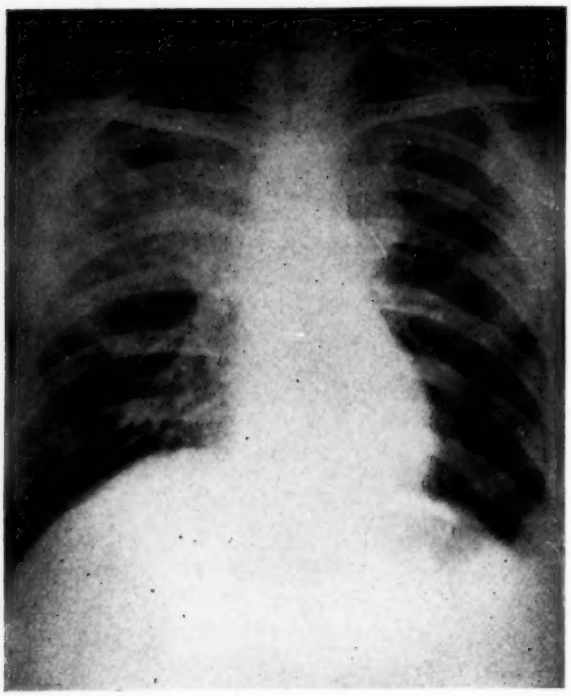

Fig. 1, Case 11. Dense mediastinal infiltration extending into right lung.

areas of destruction in two ribs. That the lung may be invaded secondarily from abdominal actinomycosis was suggested by Cottle and Satterlee, who reported a case with invasion of the right lung and elevation of the diaphragm. Lord found it difficult to distinguish from a malignant condition. Perforation of the wall of the thorax, however, occurs in about 80 per cent of the cases. Torek's case was first diagnosed roentgenologically as a tumor, then as advanced tuberculosis; he did not consider the roentgen-ray examination to be of any help in diagnosis. Two types of actinomycosis of the lungs as seen roentgenologically are recognized by Turner: first, involvement of the hilum extending into the lung along the bronchi and causing extensive fibrosis, and second, parenchymatous involvement in the form of an abscess. Pleural involvement may be seen often. His case presented characteristics of both types. Sanford and Voelker reported in 1925 that in about 14 per cent of all the cases of actinomycosis reviewed by them, lesions of the thorax were present. In Vinson and Sutherland's case, reported in 1926, marked density was seen in the lower left side of the thorax, associated with bronchial fistula. Chronic fibroid tuberculosis, diffuse pulmonary neoplasm, empyema, or chronic pneumonia with pleurisy must be considered from a differential standpoint, according to Gittings and Thorpe, who saw a dense shadow over the entire left side of the thorax in the case of a child, aged five years. A solitary, fairly well circumscribed shadow in the lung, which looked like an abscess, was the picture presented in Lüdin's case. Christison and Warwick, in 1927, were of the opinion that the roentgen picture of the disease must be variable. They named four types of pulmonary involvement: bronchitic, pneumonic, pleuropneumonic, and metastatic, the existence of the last condition being questionable. Their case showed areas of consolidation scattered throughout the lungs with dense pleuritic adhesions. In one of Preston's cases the right upper lobe was invaded with dilated bronchi, as demonstrated by injection of lipiodol. In the other case the same condition was seen in the lower portion of the left lung. A combination of pneumonic infiltration in the left side of the thorax with fluid and partial destruction of three ribs allowed Halpern and Levinson to make the diagnosis of actinomycosis of the thorax. In van den Wildenberg's case there was definite mediastinal involvement, probably by continuity from infected cervical lymph nodes. He also mentioned a case of Kissling's with a dense shadow at the hilum suggesting mediastinal tumor. Elevation of the diaphragm, pleural adhesions and some fluid were the only changes noted in the thorax in a case of Geymüller, described in 1928. Johnson and Kernan described dense consolidation of the right lower and middle lobes suggesting an abscess with atelectasis; this was

relieved by the removal of a fibrinous plug blocking the right bronchus. Injection of lipiodol revealed a large abscess in the

larity to tuberculosis. Krause found circumscribed pleural involvement with bronchiectasis, enlargement of the bron-

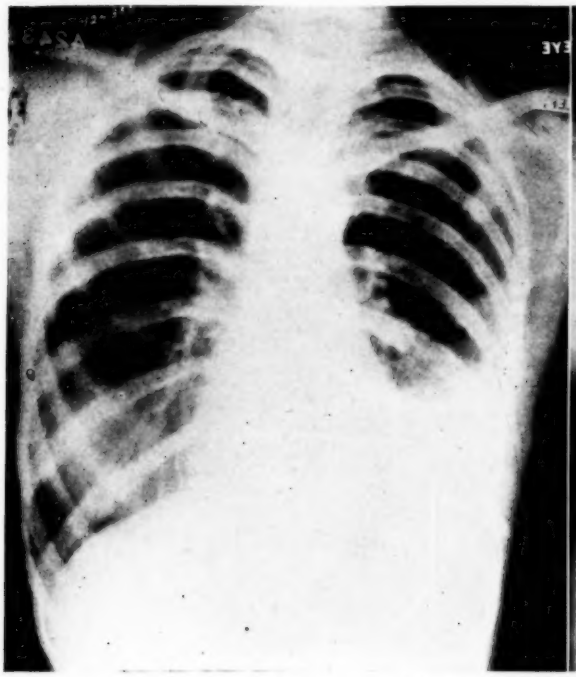

Fig. 2, Case IV. Pleuritic involvement with some fluid at base of left lung.

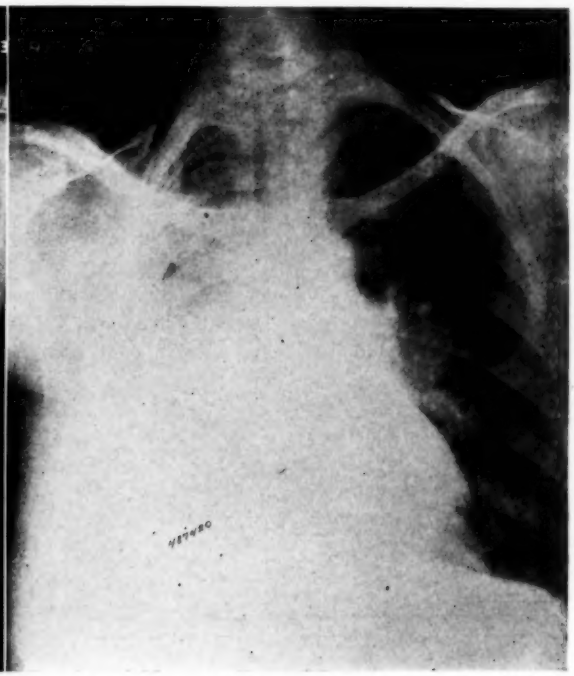

Fig. 3, Case VII. Thickened pleura on right with some fluid. Invasion of right middle and lower lobes and periostitis of third, fourth and fifth ribs anteriorly.

right lower lobe. A case described by Assmann presented a dense, uniform atypical shadow of the right upper lobe. According to Schinz, actinomycosis of the thorax is almost never recognizable by roentgen examination alone as its picture is not characteristic. In his own case there was enlargement of the hilum with increased density in the surrounding parts of the lung. Cabot, in 1929, described the roentgen appearance of a case of actinomycosis as being similar to that of pneumonoconiosis, the process being extensive, diffuse and fibrotic, with pleural involvement on the right side. Tuberculosis was diagnosed roentgenologically in Schweizer's case; increased density was noted over the lower left lobe of the lung, and an exaggeration of the shadow of the hilum on the right. Extensive cloudiness throughout the upper part of the right lung with a small amount of fluid and adhesions was noted by Chambers, and he emphasized the simi-

chial lymph nodes and perihilar infiltration in 1 case which he reported in 1929. Naegeli reported a case with pleuropulmonary involvement in the left lower lobe of the lung. In Teschendorf's case there was a large, well defined, diffuse shadow in the upper part of the right lung. Markó described 3 cases in 1929, 1 with encapsulated empyema and thick pleural adhesions, another with fluid in the base of the left lung and pericardial effusion, and a third with multiple abscesses in the upper lobe of the left lung and increased perihilar density. He recognized 3 types of pulmonary involvement: a primary type, caused by aspiration of material containing the actinomycotic organism which involves the parenchyma by way of the bronchi, a secondary type which invades the lungs by extension from the neck or esophagus, and a metastatic type which invades the lung by the blood or lymph passages, and which is

rare. Actinomycotic bronchitis does not produce any roentgenologic manifestation, according to Markó. The broncho-

Briefly summarized, the clinical and roentgenologic manifestations in the 14 cases were as follows:

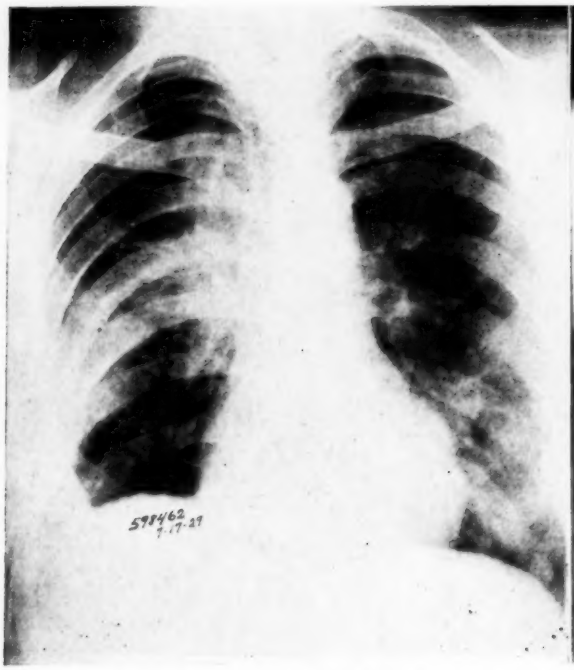

FIG. 4, Case X. Actinomycosis of middle and upper lobes of right lung with involvement of seventh and eighth ribs posteriorly.

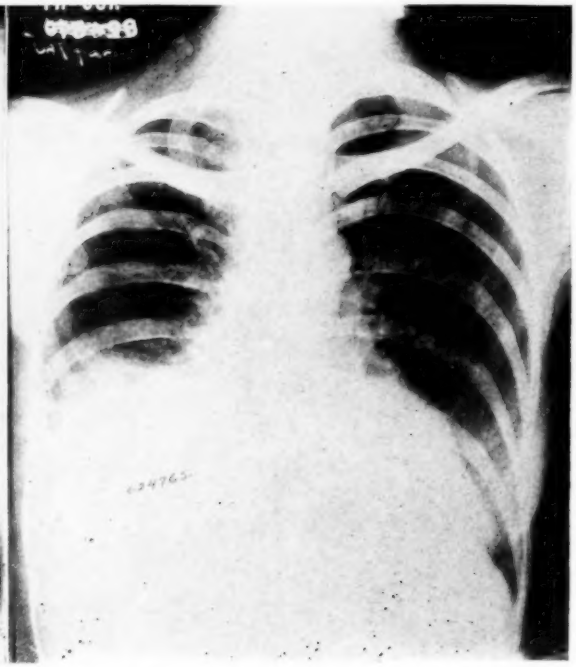

FIG. 5, Case XI. Actinomycosis of lower lobe of right lung with thickening of hilum.

pneumonic form usually invades only one lobe, the lower, and especially its subpleural portions; cavities may occur which cannot be distinguished from abscess of the lung. As characteristic must be considered the tendency to marked connective tissue proliferation, dense adhesions and dense pleural thickening, often accompanied by retraction of the entire diseased lung and by fluid. Involvement of the ribs is considered to be a rare complication.

We are able to report the roentgenologic manifestations in 14 cases of actinomycosis affecting the lungs and pleura. In all of them, the ray fungus was demonstrated in the discharge from fistulas of the thoracic wall or in the contents of an empyema cavity in the sputum. In certain cases repeated examinations and careful study were required to discover the organism, and it is evident that actinomycosis cannot be excluded by a single examination.

CASE I. A woman, aged thirty-nines, year had multiple abscesses of the wall of the thorax, following mastitis eleven years before. She had had an abdominal abscess three years before; pus from the thoracic sinuses contained actinomyces. Roentgenograms disclosed the presence of destruction of the right second rib and upper portion of the sternum on the right side. The pleura on the left side was thickened, and the heart was markedly displaced to the left; coarse infiltration with abscess in the left upper lobe was noted.

CASE II. A man, aged thirty-three years, had had a discharging sternal sinus for six months. Sulphur bodies were found in pus from the sinus. Roentgenograms disclosed fairly dense mediastinal infiltration, enlarged hilums with dense infiltration radiating into the right lung, particularly toward the upper lobe, and a small area of destruction in the sternum (Fig. 1).

CASE III. A man, aged fifty-five years, had multiple sinuses in the lower right thoracic and abdominal walls for eight years following

operation for an abdominal abscess. The ray fungus was found in pus from the sinuses. Roentgenograms disclosed elevation of the right side of the diaphragm to the level of the fourth interspace anteriorly, a thickened pleura, and enlargement of the shadow of the hilum on the right side, with dense infiltration radiating into the lung.

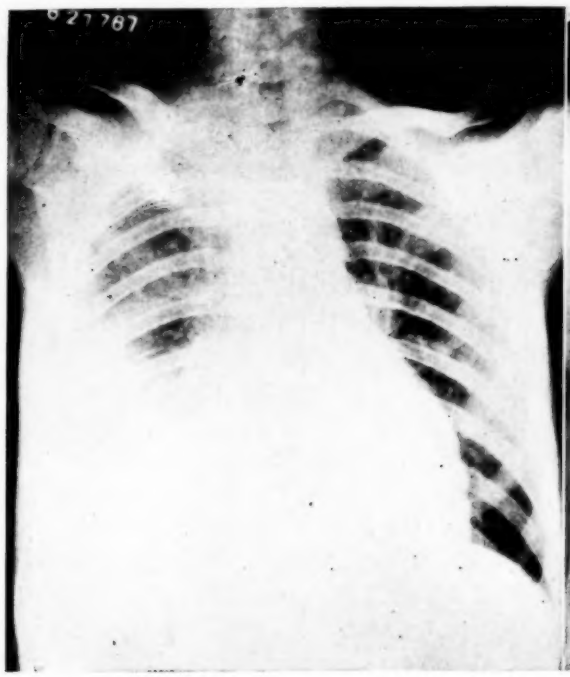

Fig. 6, Case xii. Actinomycosis of lower lobe of right lung with thickened pleura and small amount of fluid.

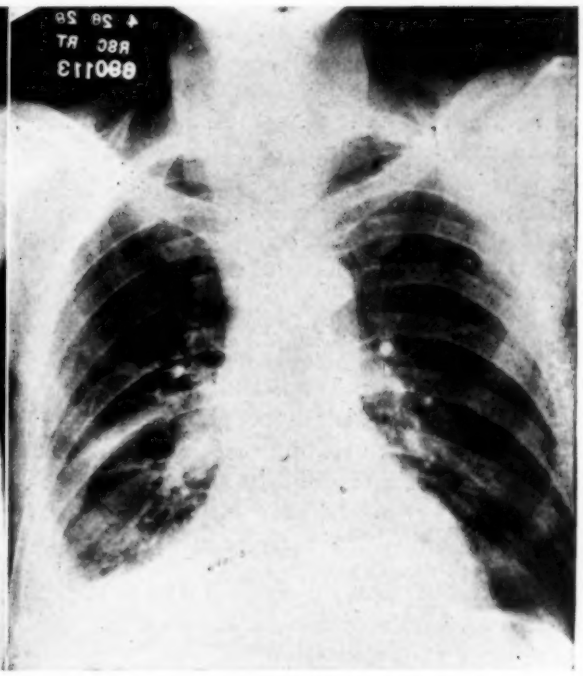

Fig. 7, Case xiv. Actinomycosis of lower lobe of right lung with involvement of pleura, interlobar pleurisy and small amount of fluid.

Case iv. A woman, aged twenty-two years, had had draining sinuses in the left breast and wall of the thorax for one year. Sulphur bodies were demonstrated in pus from the sinuses. Roentgenograms disclosed a thickened pleura and a small amount of fluid at the base of the left lung (Fig. 2).

Case v. A man, aged forty-five years, had had thoracic sinuses following an operation for empyema four years before examination. A smear was positive for actinomyces. Roentgenograms disclosed elevation of the diaphragm to the fifth rib anteriorly, thick pleural bands and adhesions, a rather dense hilar shadow with infiltration toward the lung and periosteal thickening of the eighth and ninth ribs posteriorly.

Case vi. A woman, aged twenty-nine years, had had an appendiceal abscess six months before examination, followed by a persistent sinus, right-sided empyema, and thoracic fistula. The ray fundus was found in the sputum. Roentgenograms disclosed marked elevation of the right side of the diaphragm, thickened pleura, and dense pleural adhesions. The right hilum was definitely enlarged and the right upper lobe was infiltrated.

Case vii. A man, aged forty-seven years, had had pneumonia followed by empyema five years before examination. Thoracotomy was followed by multiple abscesses of the wall of the thorax. Actinomycotic organisms were demonstrated in pus from the abscesses. Roentgenograms disclosed thickening of the pleura on the right with some fluid, uniform, rather dense infiltration of the right middle and lower lobes, and definite periostitis of the third, fourth and fifth ribs anteriorly (Fig. 3).

Case viii. A man, aged forty-six years, had had acute empyema seven months before examination. Surgical drainage was followed by multiple sinuses. The specific organism was found in pus from the wall of the thorax. Roentgenograms disclosed consolidation of the lower portion of the right middle lobe with considerable fibrosis and dense bands of

adhesions, increased hilar density, questionable abscess in the middle lobe, and partial destruction of the fifth to eighth ribs anteriorly.

Case IX. A man, aged twenty-three years, had had an appendiceal abscess eight months before examination followed by a subdiaphragmatic abscess and pulmonary symptoms. The sputum, and the pus from the abdominal sinus, contained actinomyces. Roentgenograms disclosed marked elevation of the right side of the diaphragm and thick bands of pleural adhesions.

Case X. A man, aged twenty-four years, had had abscess of the liver two years before examination. Surgical drainage was followed by multiple sinuses and the pus from the sinuses contained actinomyces. Roentgenograms disclosed infiltration of the right middle and upper lobes, increased shadow in the hilum. and destruction of the seventh and eight ribs on the right side posteriorly (Fig. 4).

Case XI. A woman, aged thirty-six years, had had an abdominal abscess one and a half years before examination. Multiple sinuses and pulmonary symptoms developed after the operation. The sputum and the pus from the thoracic and abdominal sinuses contained actinomyces. Roentgenograms disclosed dense infiltration of the right lower lobe with thickening of the hilum (Fig. 5).

Case XII. A youth, aged eighteen years, had had an abdominal abscess which had been drained surgically eight months previously. Multiple sinuses and pulmonary symptoms ensued. Actinomycotic organisms were demonstrable in fluid from the thorax and in pus from an abdominal sinus. Roentgenograms disclosed a thickened pleura, fluid at the base of the right lung, and infiltration of the right lower lobe (Fig. 6).

Case XIII. A woman, aged thirty-eight years, had had an abdominal abscess four months before examination which was followed by a sinus and pulmonary symptoms. A smear from the abdominal sinus revealed actinomyces. Roentgenograms disclosed elevation of the diaphragm on the right side, and patchy infiltration in the right lower lobe of the lung.

Case XIV. A man, aged fifty-seven years, had had an abdominal abscess one and a half years before examination, which was followed by a subdiaphragmatic abscess, empyema, and fistulas. Pus from an abdominal sinus contained actinomyces. Roentgenograms disclosed pleuritic thickening of the base of the right lung and peripherally to the level of the fifth rib anteriorly, and interlobar pleurisy on the right side (Fig. 7).

COMMENT

A review of our cases seems to indicate that pulmonary and pleural invasion often follows abdominal actinomycosis. In 8 of the 14 cases there was a definite history of abdominal abscesses, or of draining sinuses from an appendiceal abscess, or of abscess of the liver, preceding the thoracic symptoms. Three patients had had acute empyema, in 1 case preceded by pneumonia. Thoracotomy in all these cases was followed by persistent sinuses. Such formation of fistulas was also common after abdominal operations. In 2 other cases the first symptom to be complained of was mastitis followed by or in combination with abscesses of the wall of the thorax but apparently without pulmonary symptoms. It is probable that infection took place first through the skin of the breast and thorax. In 1 case only was it probable that the thorax was involved by direct extension from diseased lymph nodes of the neck. It seems that primary infection of the lung is somewhat rare. Only 3 of the 14 cases with the history of empyema can be considered as belonging to this group. In 2 cases the process appeared to have originated primarily in the wall of the thorax; in the other 9 there was a definite history of primary involvement of the abdominal organs (8 cases), or cervical lymph nodes (1 case). A draining sinus from an abdominal operation in combination with gradually developing thoracic symptoms should make one suspicious of actinomycosis, particularly if there is infiltration of the wall of the thorax with or without sinuses.

Men are more often affected than women, in this series 10 of 14. The age of the

patients was from eighteen to fifty-seven years. The shortest time between the first appearance of symptoms and the definite diagnosis made at the clinic was four months, and the longest time fifteen years. In many of the cases a diagnosis had been made elsewhere of chronic empyema with fistula. There were 3 cases in which the disease apparently had been present but not diagnosed for many years; in 1 case five years, in 1 eleven years and in 1 fifteen years. None of the patients apparently had been treated specifically for actinomycosis, that is, by potassium iodide and irradiation. These data illustrate the difficulty of establishing the diagnosis of actinomycosis of the thorax, yet only an early diagnosis gives the patient a chance for recovery. This has been shown by Desjardins in his review of patients treated in The Mayo Clinic by radiotherapy.

With respect to the site of the principal roentgenologic manifestation the cases of this series may be classified in four groups: (1) pulmonary, (2) pleuropulmonary, (3) pleural, and (4) thoracic. Eight of the 14 cases belong in group 2, 1 belongs in group 1, 4 belong in group 3, and 5 belong in group 4; in these, roentgenologically demonstrable lesions of the bony wall of the thorax were found, in each instance combined with pleural or pulmonary lesions. Except in 1 case only, pulmonary involvement led to definite pleural changes. The primary focus in the thorax was apparently in the mediastinal and hilar region. Thickened, rather dense strands radiated from these structures into the lung, particularly the right upper lobe. One might attribute this picture to invasion of the peribronchial lymphatics as described by the pathologists.

The pleuropulmonary variety was most common. When pulmonary and pleural lesions are demonstrable the mode of invasion cannot be determined definitely; it may have been primary in the lung or secondary to abdominal disease. A high diaphragm might suggest abdominal disease, but this is not a reliable index. In the 8 cases of this group, the right side of the thorax was involved in 7, and the left side in 1 case only. The upper lobes were invaded in 2 cases, in 4 cases the lower and middle lobes were invaded, and in 2 there was infiltration into the lung radiating from the hilum and not definitely confined to any one lobe.

The roentgenogram in actinomycosis of the lung is not uniform, as might be expected from the observations of pathologists. In certain cases they find carnification of entire lobes with fibrosis and many small abscesses, and the roentgenologist may find dense infiltration of one or two entire lobes. The abscesses are probably not large enough to be seen in roentgenograms; in our series they could not be distinguished. Another variety described by pathologists is a patchy involvement of parts of the lungs with or without the formation of abscess; this was seen in 3 of our cases. Definite breaking down into cavities is sometimes seen. Unlike other abscesses, those caused by actinomycosis may be subpleural and usually other areas of infiltration which are not broken down may be demonstrable. Occasionally invasion of the lung apparently radiating from the hilum into the lung by way of the lymphatics can be seen. In such cases it seems impossible to determine whether the nodes of the hilum are secondarily invaded. The bronchitic type of actinomycosis is more nearly approached; this is also recognized by pathologists. Combined with the pulmonary lesions is definite involvement of the pleura, either with or without fluid, and with a more or less fixed diaphragm. Characteristic of these pleural changes is marked thickening and very dense and broad pleural bands. However, a definite differential diagnostic sign from chronic empyema is not present. The same holds true in the cases of actinomycosis in which pleural involvement is the only sign, although a high diaphragm might lead one to suspect abdominal actinomycosis attacking the pleura by extension through the diaphragm. There were 4 cases of pleural

involvement alone in our series, and the roentgenograms of the thorax were not sufficient for the diagnosis of actinomycosis or even for a surmise of its existence.

There is only one roentgen sign which when present might help materially to establish a diagnosis of actinomycosis, that is, involvement of the ribs or sternum. This may be shown by areas of destruction, with or without the reaction of osteomyelitis around it, or periostitis. Not all sinuses of the thoracic wall lead to such areas in the bones; only 5 of our 14 cases furnished such evidence. Such signs, together with evidence of thickened pleura, empyema and pulmonary involvement, are more indicative of actinomycosis than of any other disease. Tuberculosis of the lung certainly will rarely, if ever, produce such a picture. A chronic abscess of the lung with empyema would not lead to destructive changes in the ribs. One must examine the ribs carefully, and often only a stereoroentgenogram will permit discovery of the pathologic changes. Without these changes in the rib purely roentgenologic differential diagnosis from chronic abscess of the lung with or without empyema, from chronic tuberculosis, or from chronic empyema with thickened pleura, seems impossible. The history, the general examination, and the search for the specific fungus, must then be called on for additional aid. A careful roentgenologic examination of the thorax should be made in all cases of actinomycosis, particularly if thoracic symptoms are present, or if the abdominal cavity has been affected. The roentgenologic evidence may assist in the diagnosis and thus permit the institution of therapeutic measures sufficiently early to effect cure.

SUMMARY

After reviewing the literature, the roentgenologic manifestations in 14 cases of thoracic actinomycosis observed at The Mayo Clinic are described. All the cases were proved by the demonstration of actinomyces in the sputum, in the discharge from the sinuses, or in the contents of empyema cavities. In 8 of the 14 cases a combination of pleural and pulmonary changes was observed. These consisted variously of enlargement of the hilum, infiltrative strands radiating into the lung from the hilum, localized consolidations in one or more lobes, pleural thickening, dense pleuritic adhesions, and fluid in the pleura. The manifestations were wholly pleural in 4 cases, and wholly pulmonary in 1 case. In 5 cases the pulmonary and pleural lesions were associated with areas of destruction in portions of the ribs or sternum, with or without osteomyelitis and periostitis; this combination is the sole roentgenologic syndrome which is more or less diagnostic, or at least strongly indicative, of actinomycosis. Careful roentgenologic examination of the thorax in all known cases of actinomycosis, particularly of the abdominal organs, would probably lead to earlier discovery of thoracic involvement and to better therapeutic results.

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[For Remainder of References see p. 39.]

A NOTE ON THE INTRAVENOUS USE OF AN IODIDE IN POSTOPERATIVE THYROTOXICOSIS*

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POSTOPERATIVE thyrotoxicosis, a devastating, often destructive metabolic storm, was formerly a comparatively frequent complication of the surgical effort to cure toxic goiter. It was especially frequent and dreaded in advanced cases of the group classified as "Exophthalmic Goiter." Ever since Plummer suggested the careful closely observed preoperative administration of Lugol's solution with frequent checking up of the metabolic rate in order to determine the day of maximum safety of operation this complication has melted away into comparative insignificance. Its importance and frequency have been further lessened by the postoperative administration of Lugol's solution by mouth or by rectum and the intravenous injection of glucose solution. An increasing reduction in postoperative toxicosis has developed as the operative technique has become more refined: less handling and pressure, less spilling of glandular juices, absolute hemostasis, vessels secured before severance, careful suturing of capsule, studious drainage, all these have contributed their share. (The discarding of general anesthesia by use of ether was an early step reducing morbidity.) There remain, therefore, but few cases in which this postoperative complication is a real danger. These few cases, however, demand special consideration, both because of their unexpectedness and rarity and the rapidity with which the surgeon exhausts his reliable remedial measures. When hypodermoclyses, glucose intravenously, and Lugol's solution have been faithfully administered and the patient made as comfortable as possible with small doses of morphine, we are done, at least we thought so until recently.

For eleven years we had no mortality in these cases (not a large series) and comparatively infrequent morbidity of importance until the following case appeared:

M. L. No. 136806, female, forty-eight years old, married, was referred to the Methodist Episcopal Hospital by Dr. A. M. Bell of Sea Cliff, L. I. She has one living child, sixteen years of age, but has miscarried four times. Her family history was unimportant.

Her chief complaints upon admission to the Medical Service were "dizziness and nervous spells." These had been present for about two months. Her first attack coming on while she was shopping continued so long that the doctor was called and instigated careful investigation. Her admission to the Hospital (Medical Service of Dr. Cross) followed on March 29, 1930, two months after primary attack of dizziness. Other cardinal symptoms related in her history were sinus trouble relieved by treatment, but some tinnitus aurium persists, swelling in neck (thyroid) noticed for about ten years without symptoms until recently, occasional palpitation of heart. Examination revealed typical clinical picture of toxic adenoma of thyroid with hard nodule in right lobe and another in isthmus, marked exophthalmos, widened palpebral arches, marked tremor, tachycardia (120), dermatographia and marked excitability. Her blood pressure registered 138/78; metabolic rate was plus 72. During her stay in the Medical Service, rest in bed, Lugol's solution and unirritating laxatives were the essential forms of treatment. Her metabolic rate gradually declined until on April 26 the report read plus 11.8. The Medical Service considered that the desirable condition for operation had been secured, an opinion which we confirmed in consultation.

On April 28, thirty days after her admission to the Hospital, subtotal thyroidectomy was done, under gas-oxygen anesthesia preceded by routine hypodermic injection of morphine grain $\frac{1}{6}$ and atropine grain $\frac{1}{150}$. More than three-fourths of the right lobe (including a calcareous mass) and two-thirds of left lobe

* From the Surgical Department of Methodist Episcopal Hospital.
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(containing a large cyst of colloid) were removed. The operation was of more than average difficulty. Hemorrhage was somewhat more than is usual with us. Time of operation, one hour and twenty minutes. Pulse rate before anesthesia was 120 varying but little during operation and was 120 and of good quality at its completion. Lugol's solution minims 10 every four hours was ordered, dose to be doubled per rectum if patient was nauseated. (We believe in taking great pains to avoid nausea in these cases.) The first twenty-four hours were uneventful. Thereafter ensued the typical postoperative complications with rising pulse, rising temperature, persistent and increasing nervousness and anxiety, dyspnea and after thirty-six hours an evident failure in circulation. Lugol's solution was increased in dosage. Fluids were given by hypodermoclyses. Glucose was introduced intravenously in doses of 250 c.c. of 10 per cent solution. Restlessness was treated by morphine. Seventy-two hours after operation the patient seemed moribund with livid countenance, pulse 180, respirations 36, tremor constant and restlessness and anxiety vying with prostration for supremacy. Drs. Frank B. Cross and Irving Cabot saw her in consultation. In view of the unanimous opinion of physicians and surgeons that the indicated remedy was iodine and because the Lugol's solution failed to meet this indication, sodium iodide solution was given intravenously, grain 15 at first followed by a similar dose after three hours. In four hours, Dr. deWitt, the enthusiastic house surgeon telephoned to me "A miracle has happened. This woman looks almost well." Our next observation confirmed this impression. The patient was calm, comfortable, with improved color, a smiling face, pulse 130, respirations 24 and in every way she showed a most gratifying improvement. Two doses were given at twelve-hour intervals on the following day, then 10 grain doses twice a day for two days, followed by a gradual and satisfactory complete recovery. The behavior of the wound was ideal. The patient was carefully nourished. Iodide of iron was substituted for other iodine medication after five days. She was in a chair on the seventh day, and was discharged twenty-three days after operation (detained thus long because of homeward journey of thirty miles).

We reported this incident as of some therapeutic interest at the May, 1930, Staff Conference of the Methodist Episcopal Hospital.

Five days later my colleague, Dr. A. H. Bogart, performed subtotal thyroidectomy in a girl of eighteen (No. 137855) who had had a metabolic rate of plus 50 four weeks before which had been reduced after rest and Lugol's solution to plus 8 on the day before operation. The standard procedure was done without unusual event of any kind. Immediately after operation (within five hours) a violent postoperative thyrotoxicosis supervened. No favorable results having been obtained by the usual measures including 20 minim doses of Lugol's solution, twelve hours after operation 15 grains of sodium iodide solution were administered intravenously, repeated after twelve, eighteen, and twenty-four hours, and thereafter twice a day for one day, then once a day for two days. The same prompt and dramatic recovery ensued as had been observed in our own case.

We submit this brief account to call attention to the direct intravenous use of sodium iodide in postoperative thyrotoxicosis. We believe it to be superior in promptness and certainty of action to oral or rectal exhibition of Lugol's solution. We are reasonably certain that it here saved two lives. That it may save more in this diminishing group of postoperative unfortunates is the object of this note.

The principle upon which the application of this therapeutic detail is based seems sound. As Dr. Cross remarked when we suggested this measure, "Iodine is Iodine." In the emergency cited iodine is indicated. Intravenous exhibition of iodine's sodium salt places the remedial chemical directly in the blood stream in which the thyroid toxins are circulating.

Extending the application of this principle it may reasonably become a more certain routine postoperative measure for the prevention of thyrotoxiciosis in any case where excessive bleeding, undesirable fragmentation, or unusual manipulation indicates the probability of the after-coming toxic storm. Furthermore intravenous use of sodium iodide solution may prove to be preferable to Lugol's solution by mouth in preparing highly toxic cases for operation.

TWO UNUSUAL CASES OF PERINEPHRITIC ABSCESS*

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BILATERAL perinephritic abscess, although a comparatively rare disease, is probably not as uncommon as one is lead to believe by a review of the literature. Hunt,[1] in 1924, reported only one in 106 cases of perinephritic abscess seen at the Mayo Clinic in ten years, and could find only 9 cases in the literature at that time. Yet several unpublished cases were mentioned in the discussion which followed the reading of his paper. Since that time several cases have been reported and perhaps a greater number have not been published. So this case is presented, not as so much of an oddity, as it is an illustration of how persistently the opposite side should be examined for suppurative perinephritis when the clinical course of a postoperative perinephritic abscess case is not satisfactory, because the diagnosis is often very difficult before the *x*-ray shows signs of a well-developed abscess.

CASE 1. The case is that of an adult male, thirty-five years old, admitted to Dr. Henry G. Bugbee's service in the Lawrence Hospital in Bronxville, N. Y. on February 24, 1929.

Past History: Negative.

Present Illness: Began with an attack of influenza five years before admission. At the end of two weeks, the patient developed an intense pain which increased in severity for two days, then persisted as a dull pain in the right flank. Nausea, anorexia, fever, and great prostration have accompanied the pain in the side. There has been no dysuria, frequency, or hematuria.

Physical Examination: Shows a man acutely ill. Lies on his left side. He is acutely tender in the right flank; otherwise negative. Temperature varies between normal and 103.3°F. Pulse 80–100. Respirations 20–30. Urine: heavy trace of albumin, few mucous shreds, occasional flat epithelial cells, few leucocytes, and a few red blood corpuscles. Indican, acetone and diacetic, negative. Blood: 24,700 white blood corpuscles, 83 per cent polymorphonuclear leucocytes, lymphocytes 16 per cent, eosinophiles 1 per cent. X-ray: Figure 1 showed the left kidney normal in outline. Outer border of the rectus was distinct. The right kidney shadow and the outer border of the right rectus were obscured. There was no evidence of calculi. A diagnosis of right perinephritic abscess was made, and the right perirenal space was opened by the writer through a lumbar incision under nerve block anesthesia, and several ounces of foul, thick pus were evacuated. The wound was closed about a rubber tube drain. A culture of the pus showed Staphylococcus aureus.

The temperature became normal on the second day, and remained down until the seventh day, when it began to rise again. At this time, the urine was negative. X-ray of kidney, ureter, bladder was negative. Blood culture was negative. Blood count: W.B.C. 21,300, polymorphonuclears 87 per cent. The patient was very obstreperous and repeatedly pulled the tube out of the wound. These facts lead to a clinical diagnosis of retention in the right perinephritic area. Attempts to establish better drainage were unsuccessful. The temperture was intermittent between normal and 104°F. A cystoscopic examination at this time showed a negative bladder. The bladder urine showed a few pus cells. Catheterized specimens from the kidneys showed only a few leucocytes on the right side and no W.B.C. on the left. The urea on the right was 0.9, on the left 1.35. A culture showed Staphylococcus aureus.

The left side had never shown any tenderness or rigidity. X-rays had been repeatedly negative until April 5, when the *x*-ray (Fig. 2) first showed signs of obscuring the left psoas muscle and some enlargement of the left kidney. The pictures were not satisfactory because it was very difficult to rid the intestinal tract of gas. Pus was obtained from the left side with a needle, after which the left perinephritic space was opened and several ounces of pus evacuated. Culture showed Staphylococcus aureus. The temperature gradually subsided and was normal on the fourth day.

During this long period of suppuration, the patient had become extremely weak. The hemoglobin had decreased to 43 per cent. With the usual postoperative methods, including 500 c.c. of blood by the Unger method, his convales-

* Read before the Section on Genito-Urinary Surgery, New York Academy of Medicine, January 21, 1931.

cence was progressive, and he was discharged as cured on May 18, 1929. He was seen one year after operation with negative urine findings, and no urinary symptoms. He had regained his weight and strength and was carrying on his daily work as a laborer.

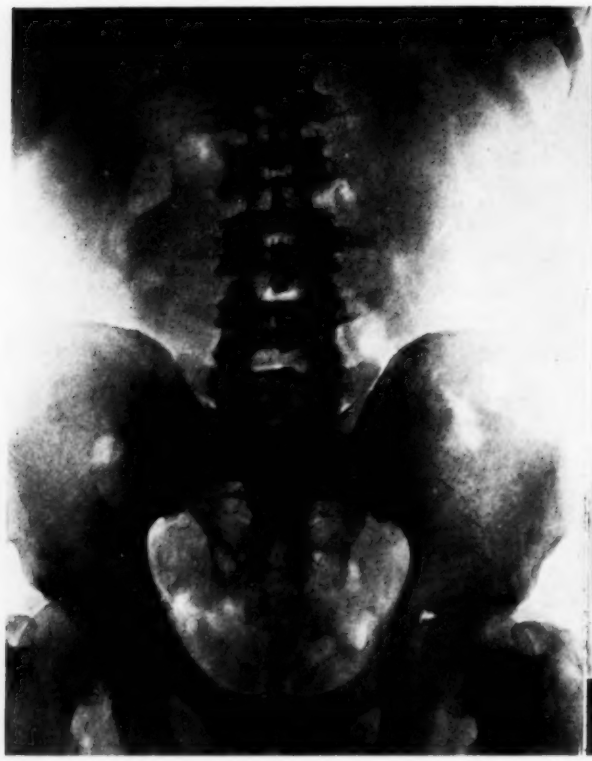

Fig. 1.

Fig. 2.

Case II. A female child seven years old, admitted to the Hospital for the Ruptured and Crippled, May 3, 1929.

Past History: Negative.

Present Illness: Six months before, she had had a tonsillectomy. She had a normal convalescence, and seemed in good health for four weeks, when she began to complain of pain in her right side. A diagnosis of acute appendicitis was made and an appendectomy performed in a local hospital. The appendix was not diseased. She continued to have pain and fever and remained in the hospital for thirteen weeks. When she returned to her home, she could not walk erect, but bent towards the right side. X-rays taken at that time were negative. She then had intermittent attacks of fever, the last attack being three weeks before admission. She did not seem to improve. Three days before, her mother first noticed a lump in her right flank. She had no urinary symptoms.

At this time, she was admitted to the Hospital for the Ruptured and Crippled. Temperature, pulse and respirations were normal. The child looked chronically ill.

General Physical Examination: Was negative, except for fullness in the right flank, which gave an appearance of a deep seated tumor, posteriorly. Urine: Catheterized bladder specimen showed a trace of albumin, many pus cells, no clumps. Blood: W. B. C. 17,500 with 64 per cent polymorphonuclear leucocytes. The R.B.C. showed a slight central pallor. A dry tap had been made and perinephritic abscess had been ruled out.

She was then seen by the writer in consultation. X-ray of the urinary tract showed increased soft tissue density over the right kidney region, and an obliteration of the outline of the right psoas muscle. Cystoscopic examination showed a normal bladder. No. 5 French catheters were admitted easily to both renal pelves. The right ureter showed four leucocytes per field. The left ureter showed 8 leucocytes per field with some clumps. A diagnosis of an old perinephritic abscess was made, and under general anesthesia, an old broken-down abscess cavity was evacuated. A pathological diagnosis of chronic suppurative inflammatory tissue was made from some of the tissue which came away with the pus. The child had an uneventful recovery and was discharged from the

hospital June 14, 1929, when there was still a very slight serous discharge from the wound.

She was advised to return for follow up, but because of the remoteness of her home, she was not seen until November 6, 1930, at which time, she was readmitted to the hospital.

Fig. 3.

Her father said that she had never been free from drainage in her side, although there had never been more than enough to saturate one gauze wipe in twenty-four hours. The child had grown, had gained considerable weight, and looked quite robust. She had had no urinary symptoms, except an occasional enuresis.

Urine analysis showed 12–15 pus cells per field, with occasional small clumps. The urine specimens collected at half-hour intervals, following the intramuscular injection of phenolsulphonephthalein showed a reading of 55-30-10 for a total of 95 per cent.

A plain *x*-ray (Fig. 3) showed no kidney outline on the right side, the outline of an enlarged kidney on the left. There was a shadow in the region of the lower pole of the left kidney which proved to be extraurinary. A lateral view (Fig. 4) shows it to be well anterior. The *x*-ray (Fig. 5) taken after the injection of the sinus tract with lipiodol, showed that the sinus tract connected with the kidney pelvis. The solution then ran down the ureter and appeared as isolated droplets in the bladder. The lipiodol was then found in a voided specimen of urine. This *x*-ray also showed the extraurinary shadow lying over the left border of the fourth lumbar vertebra. The *x*-rays after the injection of uroselectan showed a normal excretion of the dye from a left hypertrophied kidney, and no excretion of the dye from the right side.

Fig. 4.

Cystoscopic examination showed a negative bladder, except for the congestion of the right ureteral orifice. A No. 5 French catheter was passed easily to the left kidney, and a clear specimen with normal urea content was obtained. The right ureter could not be catheterized beyond 2 cm., and no further attempts were made because the examination was done without anesthesia, at the child's request, and because lipiodol had shown the ureter to be patent, and uroselectan had shown the kidney to be functionless.

Exploratory operation was done on December 3, 1930, with the hopes of removing the functionless right kidney. The kidney was difficult to expose because of the dense perirenal tissue caused by an abscess of five months' duration followed by a chronic productive inflammation of one and one-half years' duration. The kidney was finally exposed and found to be atrophic, measuring about 1½ in. in length. Exposure of the hilus and subsequent

nephrectomy were considered too hazardous. The extrarenal sinus tract was removed in its entirety, and the defect in the kidney closed

Fig. 5.

over by a suture of the capsule. The wound was closed about two rubber dam drains.

The child had a very marked febrile reaction immediately following the operation, which lasted about four days. Since then, there has been a gradual improvement. She is now ready to leave the hospital. Her side has healed. The urine analysis is negative.

This is a case of a perinephritic abscess caused by a cortical abscess, which gave no urinary findings at the time of operation; yet, in spite of adequate drainage, subsequently broke into the pelvis, and ultimately destroyed the kidney.

With the turn of the present century, urologists began to doubt if perinephritic abscess ever occurred without renal disease. Ocherblad[2] gives Ramon Guiteras credit for first calling this to his attention in 1906. Braasch,[3] in 1915, said he felt sure that the kidney was the seat of origin of all perinephritic abscesses, and he came to this conclusion after the study of 67 cases which he reported at that time.

Hunt's article, mentioned before, was very convincing because 55.7 per cent of his 106 cases showed no demonstrable kidney

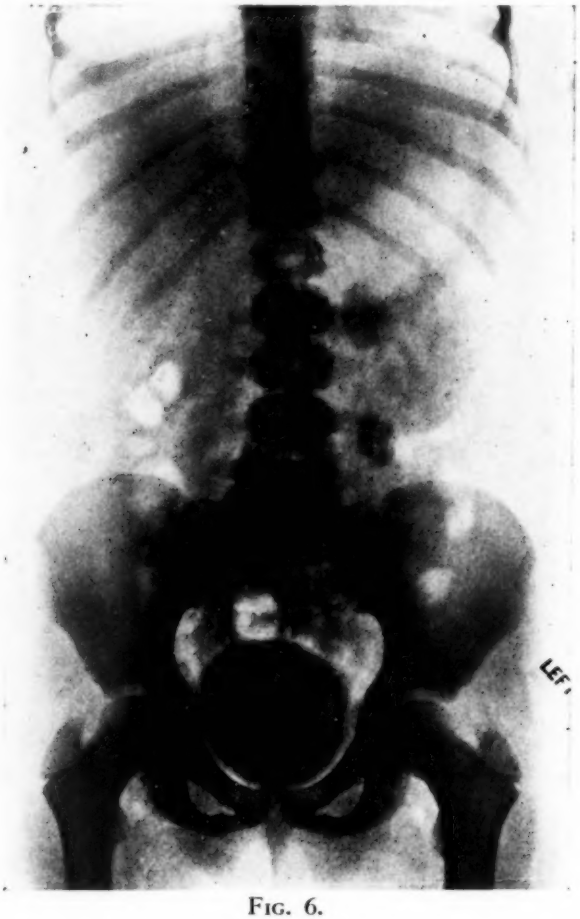

Fig. 6.

lesion, yet cortical abscesses were found in 31 of these at operation. He also reported that cortical abscesses were found in 9.7 per cent of 1835 nephrectomies performed at the Mayo Clinic. These and other publications have led to the almost universal conception of the kidney as the seat of origin of all perinephritic abscesses.

The 2 cases here presented concur with this opinion, both occurring following peripheral infection, and both showing renal disease. The first cases showed pure cultures of Staphylococcus aureus from both perinephritic abscesses, as well as from cystoscopic urine specimens collected from each kidney. In the second case, the renal origin is very obvious.

[For References, see p. 33.]
[For Discussion, see p. 21.]

POSTOPERATIVE CARE OF UROLOGICAL CASES*

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THE successful handling of a urological surgical case is directly dependent upon an accurate diagnosis, thorough preparation of the patient for operation, a well conceived and executed operative technique, and intelligent postoperative care.

Accuracy in urological diagnosis, thanks to our ever increasing armamentarium, including cystoscopy, *x*-rays, urography and intravenous urography, is possible in nearly every case; with all these methods at hand, however, a prolonged study of the case may be necessary for its accomplishment.

The value and necessity of preparation of the patient for a urological operation have been repeatedly emphasized by many and frequent contributions to the literature, and yet too much stress cannot be laid on this phase of the case. The present opportunities for studying the general physical condition of the patient, often in association with a competent internist, the many precise methods at our disposal of estimating the efficiency of the cardiovascular system and of the kidneys, with electrocardiograms and laboratory tests of blood chemistry and renal function, should give a sense of security that should leave little to be wanting regarding this phase of the case.

With the background of an accurate diagnosis and a thorough preparation of the patient for operation, an operative technique should be followed that aims towards elimination of the pathology and restoration of function, employing measures tending to minimize operative complications.

Much less has been written about the postoperative care of urological cases. The immediate care has been included in considerations of operative technique, and yet little or nothing said of their remote care.

There is no group of cases in any branch of surgery in which the remote care is more important, from the standpoint of restoration of function, permanence of cure, and general rehabilitation of the patient.

In the immediate postoperative care, there are certain general principles which are applicable to all urological cases, namely: the necessity of free drainage, forced elimination, control of hemorrhage, and stabilization of the circulation. The more satisfactory and complete the preoperative preparation, and the more accurate and finished the operative technique, the less urgent will be the immediate postoperative steps, and the more readily will the patient respond to such measures.

In all urological cases, an immediate increase in the intake of fluids is indicated, for, as the prime function of this tract is elimination, to maintain this function there must be a free supply of fluids to the body; this is administered in all postoperative cases by hypodermoclysis at the completion of the operation, by rectal injection, and by mouth, as a large percentage of urological operations are carried out under regional anesthesia.

The blood is typed before operation, that a transfusion may be given at any time, if necessary. No fixed rules or routine are followed out, but indications are met as they arise in individual cases. This applies to medication, nourishment, care of wounds, dressings, bladder irrigations, and the activity of the patient.

It has seemed to me that special considerations are due, from a postoperative standpoint, to definite classes of urological surgical cases most commonly encountered. These I would divide into (1) cases of prostatic obstruction, (2) lithiasis, (3) tuberculosis, and (4) malignancy.

The immediate postoperative care of

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cases of prostatic obstruction is so intimately associated with the preoperative preparation and the operative technique, that one can hardly discuss one without referring to the other. The patient thoroughly stabilized through proper preparation, which means that he has reached the height of his cardiovascular-renal efficiency and body elimination, together with relief of local congestion and infection, will approach the operation of prostatectomy with a reasonable assurance of a more comfortable convalescence and an expectation of fewer complications, especially if the operation is carried out under local anesthesia, with a minimum of shock, traumatism and hemorrhage. This is best accomplished by a preliminary cystostomy and ligation of the vasa deferentia. Preliminary cystostomy is often the most vital step of the operation, frequently carrying with it a more pronounced systemic reaction than the subsequent prostatectomy; therefore the care following cystostomy is most important, and consists in forced elimination by increased fluid intake, through hypodermoclyses, proctoclyses, intravenous infusions and transfusions, if necessary. Increased elimination from the intestinal tract is important. During this stage, digitalis is a valuable drug in stabilizing the circulation and stimulating renal activity. Early moving about of the patient, out of bed, is beneficial.

While hemorrhage is much less pronounced in a secondary prostatectomy, yet its control goes far towards eliminating postoperative shock.

The hemostatic bag has been the most satisfactory method of controlling hemorrhage, and has been used in most cases. Occasionally the prostatic cavity is packed with gauze placed about an indwelling urethral catheter. Traction on the hemostatic bag is seldom maintained over two hours. The bag or packing is retained in position from twenty-four to forty-eight hours and removed, an indwelling catheter replacing the bag.

Postoperative hemorrhage may occur when least expected. I have had but one hemorrhage during the first twenty-four hours, with the bag in position, and this case proved to be a hemophiliac. The bleeding was controlled by packing. Another case, in which the bag was not used, had a severe hemorrhage which was controlled by inserting the bag. A sudden severe hemorrhage occurred, in one instance, one week after operation, necessitating packing of the bladder, and still another case had repeated hemorrhages, apparently due to infection; they were controlled by repeated packing of the bladder. While none of the cases proved fatal, one must be constantly on guard against the possibility of postoperative hemorrhage, and be prepared to pack the bladder. A transfusion should be given at once, following a hemorrhage.

Local infection of the bladder, prevesical space, or the wound, has not been pronounced in any cases during recent years, since a longer preoperative period of bladder drainage has been given by urethral catheter, and supplemented by cystostomy.

During convalescence, fluid intake should be maintained at a high level, by all methods of administration.

One of the most troublesome and often serious complications following prostatectomy has been the large percentage of cases of epididymitis. The seminal vesicles are always infected at some time during a prostatectomy, but this infection clears up rapidly if it does not extend to the epididymes, as has been clearly proved since ligating the vas as a routine, during the past year and a half. Epididymitis has occurred in three instances after ligation; one of these patients had an epididymitis before entering the hospital, and the other two had a well-marked seminal vesiculitis before the ligation, and in all probability the infection already involved the epididymes as well. In these cases the attack was less pronounced and of shorter duration than in other cases in

which ligation had not been carried out.

The elimination of this complication removes one of the most trying immediate and remote complications of prostatectomy, one that is painful, distressing, and one that greatly weakens and lowers the morale of the convalescent.

Very little emphasis has been placed upon the continued care and observation of the patient after prostatectomy. To turn such a patient out of the hospital with the healing of his wound, with no instructions as to further care, is entirely wrong.

It has been my experience that these men of advanced years are decidedly weakened by the operation, and how much so may only be appreciated as they begin to resume activity. Under mental and physical effort they tire readily. The circulation often shows impairment for a long period of time. Edema of the extremities is not uncommon; phlebitis is an occasional complication. Such patients should be under the observation of the urologist and the internist until brought back to their best possible physical condition.

Continued observation after operation shows remarkably good urinary function in almost every case. Wounds heal readily as infection is cleared up before operation. Contracture of the vesical neck, requiring dilatation, has been noted only in a few cases of fibrous prostate removed by enucleation or by the punch operation, and in one case of prostatic calculi with long-standing infection of the prostate and vesicles.

The prostatic capsule often becomes much thickened after operation, probably due to small compressed pieces of adherent prostatic tissue which are not removed, and which later undergo hypertrophy. Routine rectal examinations subsequent to operation, often show, months or years later, apparently a considerable amount of prostate. In none of our cases have I seen any obstruction from this cause, but I have re-operated upon three patients originally operated elsewhere.

All cases of fibrous prostate should be under observation for an indefinite period. Occasional dilatation of the vesical neck or repetition of the punch operation may be necessary. Atony of the bladder muscle slowly improves as the relief of obstruction is maintained.

Expression of the contents of the seminal vesicles should be carried out at intervals until they are found to be clear of infection. It often requires years for such infections to subside; occasionally they give rise to attacks of neuritis and arthritis, although, as before stated, with ligation of the vas, these infections have been less persistent.

The following urological lesions have been encountered in conjunction with prostatic observation: vesical calculus, vesical tumor and diverticulum, ureteral calculus, renal calculus, and pyonephrosis. In cases of vesical calculus, tumor or diverticulum of the bladder, such lesions were removed before doing a prostatectomy. In the cases of ureteral calculus, renal calculus and pyonephrosis, no operation was done prior to the prostatectomy, but the necessity of watching such cases after prostatectomy, is obvious, and subsequent operations for their removal should be carried out, if indications arise.

The association of the formation of urinary calculi with the presence of focal infections in and outside of the urinary tract, the close connection between interference of urinary drainage from the bladder or kidneys, also disturbed body chemistry and poor intestinal function, with the production of calculi, is such that a satisfactory result in any given case of lithiasis must depend not alone upon operative relief, subsequent to an accurate diagnosis and preoperative preparation, but upon the after care of the patient, in an attempt to restore function to its maximum and prevent the re-formation of calculi.

The maintenance of free urinary drainage, employment of kidney lavage, forced fluids, and urinary antiseptics, in an

attempt to eliminate infections of the urinary tract, will prove of decided value in preventing the recurrence of calculi. All cases of lithiasis should be under periodical observation for an indefinite period, and should have a check with *x*-rays from time to time. Even under the closest observation, and the employment of every known means of precaution and treatment, calculi may re-form; in such instances, however, much benefit will be derived from these measures.

When one realizes how many cases of lithiasis require nephrectomy; how many cases are bilateral; the frequent combination of renal and ureteral calculi; and the frequency of coexisting infections throughout the urinary tract, the importance of conservative surgery and the restoration of function and elimination of infection in the operated kidney or in the remaining kidney, if nephrectomy has been necessary, is appreciated. A recurrence following nephrectomy means operating upon a single kidney. The possibilities of restoration of function from postoperative treatment leads one to adopt conservative surgery if possible, and the amount of restoration of function which takes place in some cases, is often most surprising.

A man of fifty-four was operated on eighteen months ago for the removal of a giant calculus from the left ureter. The calculus filled the ureter from the bladder to a point above the pelvic brim. The ureter was enormously dilated, the kidney showed infection and poor function, no dye appearing in the urine from this side. Following a uretero-lithotomy, the kidney examined one year later showed good function and only a slight infection. This patient has been under medical observation and has no urinary symptoms.

A child four years of age was operated fifteen months ago for a large vesical calculus and a large calculus in the right ureter. She has been under postoperative care and is now free of infection with good function of both kidneys and no recurrence, as shown by *x*-rays taken during the past week.

The elimination of focal infections so frequently found about the teeth, in the tonsils and sinuses, should be an important element in the postoperative treatment of lithiasis.

By means of diet, medication, and increased elimination from the intestines, calcium oxalate, and uric acid crystals may disappear from the urine, and often by changing the reaction of the urine phosphaturia may be controlled.

In one patient under observation for the past ten years, during which time I operated upon both kidneys and one ureter for large obstructing calculi, it has been difficult to maintain an acid urine, and to hold the kidney infection in check, yet under the previously mentioned routine of diet, medication, and kidney lavage, a calculus which re-formed in each kidney, has not changed in size during the past two years, and the patient is comfortable.

Under such postoperative treatment, recurrences in cases of lithiasis have been rare.

It is generally conceded that tuberculosis of the genito-urinary tract is not a primary lesion, but secondary to a tuberculous focus elsewhere in the body, which has lighted up during a period of lowered body resistance. At such a time, patients are poor operative risks and should be placed upon a regime which will improve their resistance and diminish the activity of the acute lesion, before operative interference is undertaken. Even when this has been accomplished, operation such as nephrectomy or epididymectomy often results in renewed activity in secondary tuberculous lesions in the genitourinary tract, as in ureter or bladder after nephrectomy, and prostate and vesicles after epididymectomy. Quiescent foci in other parts of the body may become active, so that after operation, every effort should be made to increase body resistance. Exposure of wounds to sunlight and the Alpine lamp is most beneficial. Santol-ol is soothing to

the bladder lesions. Tuberculin may often be administered with benefit.

Tonics and open air are indicated, and as soon as possible following operation, the patient should be moved to the best possible climate, and treated as a case of general tuberculosis, by rest, open air, and general supportive treatment.

To discharge a patient from the hospital, following an operation for tuberculosis of the kidney, with no instructions and no further watching, may be worse than not operating. A tuberculous ureter may continue active, and bladder lesions may not heal. Symptoms continue, the opposite kidney may become involved, or other active foci lead to an early mortality, while, under more favorable surroundings and intelligent care, a cure would be probable.

Three patients having bilateral tuberculosis, in whom the process became arrested in one kidney, were subjected to nephrectomy, the more extensively involved kidney being removed, and under general postoperative treatment, all are alive, one, five years after operation. One patient having a single tuberculous kidney has been under observation for sixteen years, and under general systemic care, is enjoying good health and is free from urinary symptoms. Exploratory laparotomy proved the absence of the opposite kidney.

A realization of such forces of nature should be recognized and utilized to the utmost, observations being continued over an indefinite period of time.

The postoperative care of urological cases of malignancy might be summed up in the words "eternal vigilance." Whether the growth be in prostate, bladder, kidney, or in the testicle, and the operation be a radical removal of the tumor, if fortunately diagnosed at an early stage, when removal may be possible; or whether the growth be treated by radium, diathermy or deep radiation, in an attempt to destroy or control it, the future of the case depends upon regularly repeated observations. Furthermore, only by such postoperative care is it possible to evaluate the different methods at our disposal, of treating malignancy.

I would like to cite a few cases which I believe justify the importance of such postoperative care.

J. P. Complete retention of urine in 1920. Cystotomy revealed a carcinoma of the prostate. Radium needles were inserted suprapubically and through the perineum. Suprapubic wound healed four weeks later. Toxemia subsided. Complete return of urinary function. Radium administered one year later. Patient under periodical observation and general tonic treatment. Prostate now small, smooth, no nodules. Gained 25 lb.; in excellent health.

A. T. Carcinoma of prostate, 1922, (prostate large, stony hard, nodular, fixed). Radium needles inserted through the perineum; residual reduced from 4 oz. to none. One year later needles again inserted for slight recurrence. Since then, under regular examination and cystoscopy, shows no recurrence, is well, has good function.

Nine patients undergoing prostatectomy since 1922 showed, on pathological section, a carcinoma with prostatic hypertrophy. One case developed general carcinomatosis one year later. A second shows a small hard nodule in the prostatic capsule which has not increased in size for two years. The others have shown no recurrence.

A patient with a stony hard nodule of carcinoma recurring after a partial prostatectomy, has been made comfortable by radium seeds inserted into the growth through the perineum.

X-ray films showing the position and number of radium seeds that have been inserted, are taken at intervals, and, in conjunction with other urological examinations, are an aid in checking off the condition, and as a guide for further radium treatments.

This postoperative care has shown that much can be done in some cases of carcinoma of the prostate in giving prolonged relief, and occasionally effecting a cure, in this most difficult and distressing class of cases.

These remarks are more applicable to

cases of bladder tumors, where recurrences are noted in such a large percentage of cases, and in which recurrences may be detected easily by cystoscopic examination. Recurrences respond more favorably and more rapidly to fulguration than do the primary growths, especially after radiation, and they may often be eradicated if detected in their incipiency. Here deep radiotherapy and radium are valuable adjuncts, often advantageously applied together. Results will be in direct proportion to the time at which the growths are detected and treated.

It is customary to have cases of bladder tumor return for observation every month after operation. Later, the intervals are lengthened, but not over six months, for the first five years.

One case of extensive infiltrating carcinoma of the bladder has been free of recurrence for nine years, after radium implantations. A second patient, having the infiltrating type, was re-operated three years ago, radium seeds again implanted, was then given radiotherapy, and the bladder has been clear of growth since that time. In this case, a radium seed was recently removed from the bladder wall three years after implantation, leaving a smooth, cupped-out area. A case of papillary carcinoma operated seven years ago by resection, developed a small recurrence five years later, which was removed by fulguration, and has been free of growth since then. Another case resected sixteen years ago has developed numerous small recurrences, which were detected by periodical cystoscopic examinations, although no symptoms were present. These recurrences have been destroyed by fulguration, and the patient is now clear of growth.

Many similar instances might be mentioned which demonstrate the value of postoperative care of cases of bladder tumors, the necessity of periodic cystoscopic examinations, and the possibility of maintaining freedom from growth by the early detection and eradication of recurrences. The absolute necessity of such a course should be fully explained to the patient, and he should be held responsible for its fulfillment.

The possibility of recurrence of renal tumors, especially of those of the renal pelvis in the ureter and bladder, if a nephroureterectomy has not been carried out as a primary operation should be remembered and periodical cystoscopic examinations made, in hopes of detecting such recurrences at once. Cases of renal tumor should be examined regularly for the presence of metastases. Deep radiotherapy of the kidney region may be beneficial in inhibiting local recurrences.

In all cases of tumor of the testicle, deep radiotherapy should be applied to the wound region, inguinal and renal regions, after the removal of the growth. Some observers advise radiotheraphy before, as well as after operation. Two patients with carcinoma of the testicle, given radiotherapy after removal of the growth, have been free of recurrence five and three years after operation.

One might infer from these remarks that, once a urological case, always a urological case, which is true to the extent that the urological history should always be borne in mind in questions of health that may subsequently arise in the individual.

The intimate connection of surgical lesions of the urinary tract with the remainder of the body, such as prostatic obstruction with kidney function and the circulatory system; tuberculosis with tuberculous lesions in other parts of the body; lithiasis with the various body functions and focal infections; and malignancy with metastases, render a study of the whole body imperative, and a proper restoration of function and health, with a maintenance of the same dependent upon a carry-through. This means the utilization of every means of postoperative treatment, and continued observation over long periods of time, with the employment of suitable measures at a time when recur-

rences of pathology are detected in their incipiency and may be eradicated.

In no other class of cases is this follow-through of more importance, and the urologist holds no claim to results until the patient has been placed upon his feet, free from complications, and has passed the probable period of relapses and recurrences.

As before stated, true evaluation of various urological procedures can only be determined by such postoperative study.

From time to time there is a burst of enthusiasm for an operative procedure seemingly new, yet, upon investigation, found to have been tried out years before. With refinements in our diagnostic technique, methods are resurrected, and reports comprising the immediate results from such procedures are often voluminous and optimistic; yet how seldom are these reports supplemented by others giving ultimate results five or ten years later.

The so-called elusive ulcer of ten years ago was looked upon as a pathological entity to be cured by bladder resection. The immediate results of operation seemed to be excellent; yet as time went on, postoperative observations and treatment showed that recurrences were the rule, that the lesion was an interstitial cystitis, that elimination of focal infections of the kidney and outside the urinary tract was necessary to effect a cure, and, furthermore, that local treatment of the ulcers by instillations of silver nitrate and by fulguration, gave better results than resection of the bladder.

Less and less is heard of ureteral strictures as a pathological entity. Continued care and observation of cases so diagnosed, have demonstrated their connection with other lesions, and a broader comprehension of this subject has lead to a dampening of enthusiasm for specific operative methods of relief, with a substitution of a line of treatment aimed to relieve a condition of which ureteral pathology or disturbed ureteral function is an integral part.

The past few years have seen a renascence of kidney fixation, largely due to present methods of urological diagnosis, in part, to the fact that attention has been focused upon the ureter as a cause for symptoms. The period of enthusiasm of thirty years ago is more or less forgotten, and while the pendulum may have swung too far in the opposite direction, there undoubtedly being an indication for nephropexy in carefully selected cases, yet this present stage should be supplemented by postoperative observations made over a period of years, with accurate reports as to the permanency of symptomatic relief. The same holds true for plastic operations upon the renal pelvis.

It was to be expected with the perfection of cystoscopes and ureteroscopes that further attempts would be made to relieve vesical neck obstructions by various palliative operative methods, and here again postoperative study, and records extending over a period of years, are necessary to give a true evaluation of the results of such methods.

There are many difficult problems in urology, how difficult can only be appreciated by reviewing the literature of the specialty and a study of the various means that have been devised to combat these problems. Enthusiasm, while of value, should be tempered by results, which, in turn, must be viewed over periods of years.

Every pathological entity and operative technique eventually finds its proper place. This, however, is only determined by prolonged postoperative study.

In urological surgery we are not alone concerned with the question of mortality, but with the restoration and maintenance of function and good health.

DISCUSSION OF PAPERS BY DRS. TAYLOR AND BUGBEE

Dr. B. S. Barringer: If after an operation you are called up by an anxious house staff because the patient is bleeding or doing badly, there has probably been some lack in the preoperative care or operation, or a matter called

luck has gone against you. Such patients have probably not more than a 75 per cent chance of living. The preoperative care of these patients is very important, as Dr. Bugbee has emphasized.

As for the postoperative complication of hemorrhage; I do not ordinarily use packing, but if a general surgeon, who is accustomed to packing, has charge of the case, I use it, too. He would not know how to manage anything else and I find that is a very sane procedure. I have seen cases that packing would not control. If the patient has no prostate cavity, packing does not stay put. The hemorrhage is controlled by a little gauze down to the bleeding point. I have seen a patient die immediately on the removal of the packing, I do not know why, whether from shock or embolus. If the packing is difficult to take out, leave it alone until it is ready to do so. I agree with Dr. Bugbee that the bag is the thing to use.

A failing kidney function postoperative is rare. I think it usually occurs with a failing heart function. You see the patient not doing well, and then you find the urea, etc., going up; and if you are wise you will go over the heart carefully and will probably find that proper digitilization will bring it back.

Another complication is paralytic ileus. I see very few cases of this; I do not know why except that I think perhaps because I use spinal anesthesia almost exclusively. Last week I had a case in which I could not use spinal anesthesia. The patient had a moderate stone in the kidney which necessitated pyelotomy. He had general anesthesia, and died of paralytic ileus. There is something in spinal anesthesia which seems to me to make the postoperative convalescence unusually good.

As for epididymitis, I do not do the routine ligation of the vas, because I see very few cases of epididymitis; and while the prostates I see are few compared with the bladder tumors the proposition is the same; I think one reason may be that I do not put catheters in the urethra postoperatively unless there is a very good cause. After taking out the packing or bag from the prostate, I do not put a urethral catheter in place.

Dr. Bugbee's point that it takes a long time for a prostatic to get entirely well, is well taken. It requires at least six months for the patient to get back his vigor and weight, and we ought all to realize that.

A word about carcinoma of the prostate: Some years ago I made a rash statement that 10 per cent of such cases are controlled by radiation through the peritoneum. I still hold to that. But most cases are radiated too little. I therefore put in radium suprapubically, which means a 5 per cent mortality. I do this because I believe we can gain another 5 per cent, and go from 10 to 15 per cent in controlling prostatic carcinoma.

A word about the postoperative care of bladder tumors that have been radiated. I am loath to instrument these for a long time, and I keep all instruments out of the bladder for a number of months if possible. You are fairly safe if your radiation has been done carefully; but if your patient bleeds after you have radiated the bladder tumor that patient has in 70 per cent of cases a recurrence. If he does not bleed, let him go four to six months before you cystoscope him.

Dr. Edwin Beer: Referring to Dr. Taylor's paper on perinephric abscess, during twenty-odd years only 3 cases of bilateral cortical kidney abscess, usually due to staphlococcus aureus, have been seen by me.

Most perinephric infections are due to cortical kidney abscess, and the earlier one operates, the more easily this origin is demonstrated. Late operations for perinephric abscesses do not expose the kidney. In earlier operations, when the pathology is just beginning, the kidney is usually seen or felt, and the surface cortical suppuration is readily detected. It is perfectly conceivable that some cases may start in the perinephric fat, some cases by extension of adjacent suppuration. Many cases are due to a mild bacterial infection, and the symptoms are protracted and very difficult to interpret; in fact, I nave seen some cases run two and a half years before correct interpretation and treatment. Only recently we have had 3 of these cases on my service at Mount Sinai Hospital.

One was a child, who had been suffering from febrile attacks for almost two years. Intravenous pyelogram, made with either uroselectan or skiodan, I have forgotten which, suggested a neoplasm. Local tenderness suggested a cortical carbuncle, which was found at operation. Usually in these cases, the perinephric fat is very much indurated, and thickened; at times it has been seen to be as thick as the shell of a cocoanut. In this case the perinephric

reaction was purely local in and about the region of the cortical carbuncle on the anterior surface of the kidney. This was separated, and the perinephric ab scess, which led down to the kidney, was drained, the kidney being saved.

These ante-renal suppurations are particularly misleading, as they produce intra-abdominal peritoneal symptoms. Another patient, very similar to this child, had a cortical abscess, which was peracute, on the anterior surface of the kidney, which in some way affected the vascular supply of the lower two-thirds of the kidney. The patient, following incision and drainage with decapsulation of the kidney, continued to run temperature, which could not be explained by retention, as the wound was digitally explored regularly for several weeks, and no pus found. In this case, a secondary nephrectomy led to a cure, the lower two-thirds of the kidney being out of commission.

Another case, operated upon at a somewhat later stage, was incised and drained, kidney not seen or felt. In this recent series of 3 cases, in 2 out of 3 the origin of the perinephric suppuration was demonstrable as a cortical kidney lesion.

It is important in these cases to be sure, if the patient's temperature continues, that the second kidney is not involved, as occasionally bilateral cortical abscesses are encountered, and if one is too radical at the first operation and removes the kidney, and subsequently the second kidney has a similar infection, the patient is likely to be in difficulty.

As far as *x*-ray diagnosis is concerned, although not present in all cases, obliteration of the psoas muscle and curvature of the spine to the opposite side has proved a great aid as a confirmatory physical sign. Frequently *x*-ray has suggested the possibility of perinephric suppuration, when previously the physician had scarcely thought of this possibility. During the last year such a perinephric abscess was recognized by the *x*-ray department in a patient on whom I had done a nephrectomy years before. For a long time I could not convince myself that she was tender and had perinephric suppuration. The stump of ureter on that side showed no retention. *X*-ray showed typical signs. Finally, when tenderness and pain in the right lumbar gutter became more evident, a large pus pocket was evacuated from the side where the kidney had been removed. Subsequent observation of this case showed that the abscess started in a diseased spine.

My experience points against the use of aspirating needle for diagnosis in these perinephric suppurations, as I believe aspiration is occasionally likely to be a dangerous procedure. Sometimes the needle traverses the kidney and produces an abscess in this organ, especially when it first traverses the infected abscess and then enters the kidney. I believe diagnosis should be made without aspiration and confirmed by exploratory incision if necessary. If one relies upon a negative aspiration and does not incise and drain, one may make a serious mistake, as the pus may be too thick, or it may not be located in the path of the needle.

As for Dr. Bugbee's discussion, he has covered the whole field, and I can only express my approval of his careful, complete work. In the case of prostatics, I believe that after prostatectomy serious bleeding which is uncontrollable is rare, if one uses a very large drainage tube. If the tube is too small and the blood clots within it, the tendency is to spread open the prostatic bed, which allows the vessels to open up and bleed. In addition to the large tube, a long packing of gauze soaked in thromboplastin seems to be of assistance. The end of this is slipped into the prostatic bed, the balance of the gauze remaining in the bladder, so that it compresses the neck of this organ where the bleeding usually arises. The tube presses against this gauze, as the patient sits up in bed right after the operation, and the large tube, plus gauze and the sitting position, seems to be effective. Thromboplastin probably helps to some extent.

On removing the packing, one can do so painlessly by introducing some novocaine through the drainage tube about half an hour before the gauze is removed. The novocaine is poured in through the suprapubic tube, which has been disconnected from the urinal. The tube is clamped off, and in twenty to thirty minutes the dressing is done, tube removed and the gauze easily and painlessly extracted. The extraction of the gauze used to be more painful than anything else. By this simple method the pain is reduced to a minimum. At the same time that the gauze and the tube are taken out, the urethra is washed through so that free flow of water pours from the suprapubic wound. If there is any bleeding following this procedure,

the bladder is washed out and a tube of smaller caliber introduced for a day or two. When the bleeding has ceased, one of my suprapubic cups is attached, and the patient left absolutely alone without instrumentation until his bladder is closed. If there is a long delay, the patient not voiding for three weeks or so, an indwelling catheter may be introduced to deflect the stream from the sinus and the cup.

Occasionally there is bleeding a week or so after removal of the packing due to separation of some sloughs or tabs. If this is severe, it may have to be controlled by repacking, but usually reintroduction of a large suprapubic tube with hot irrigations will control the situation. Only in very severe secondary hemorrhages, which are rare, is transfusion, etc., required.

Occasionally following prostatectomy, when the patient is healed, one sees an obstruction due to narrowing of the neck of the bladder. At times one sees a diaphragm which is formed at the neck of the bladder. These formations may lead to slow healing of the wound, though there are many other causes for persistent suprapubic fistula following protatectomy. Fortunately most of these causes can be relieved by passage of a sound which separates the adhesions which have formed abnormally at the neck of the bladder. Some cases, however, have to be re-operated upon, and the deformity excised.

Another complication, which is rare, is a certain degree of incontinence. This is usually relieved by re-education or by instiliations into the posterior urethra of silver. Whether these complications are due to injury of the sphincter or are due to overpacking in the prostatic bed is difficult to determine. In all cases there is serious injury to the internal sphincter, as is evidenced by cysto-urethroscopy, by *x*-ray studies of the posterior urethra after prostatectomy, and by the fact that the patient retrojects into the bladder. Whether this same retrojection occurs after perineal prostatectomy as after suprapubic prostatectomy I have not been able to find out.

In my experience these old gentlemen made a very quick convalescence. Within two or three months after discharge from the hospital they are quite spry and active. In some of them the urine becomes quite clear, or absolutely clear. In those whose bladders were very distended for some time prior to operation and in which many pouches have developed, absolutely clear postoperative urine is probably never obtained. I have, however, repeatedly seen clear urine, without any evidence of macroscopic pus in cases where the bladder was not deformed.

I agree with Dr. Bugbee that stones and diverticulae should be removed at the first step, before prostatectomy is done.

In the study of the *x*-ray treatment of tumors, whether they be primary tumors or recurrences; whether they be renal or bladder, I have seen no results.

In tumors within the pelvis of the kidney, the only surgical treatment is complete nephroureterectomy with excision of the meatus in the bladder. Recurrences in the ureter stump are so frequent in these papillary tumors of the pelvis of the kidney that one should do a complete operation at the first stage, rather than go in after the ureter secondarily.

In tuberculosis of the urinary tract, the operation is only part of the treatment. Patients who can take care of themselves, look after their personal hygiene, are much better off prognostically than the poor patient, who has to get to work. Postoperative hygiene is most important and surely will improve the end-result.

Dr. Bugbee's female patient who ran for sixteen years with renal tuberculosis and is still alive with clear urine is surely a very exceptional observation. If the case had occurred in a male, I might have been in doubt as to contamination of specimens from a prostatic tuberculosis.

In the treatment of carcinoma of the prostate, in view of the great variety of courses that the disease runs, it is very difficult to decide whether one is effecting a cure by one method or another. Some of the cases seem to drag on for years and years without any treatment; on the other hand, others metastasize very rapidly and lead to a series of complications. *X*-ray in some cases seems to benefit these patients, though the evidence is not absolutely clear.

In connection with tumor of the testicle, the evidence seems to be in favor of *x*-ray treatment of the original tumor prior to operation.

In view of the numerous subjects touched upon by Dr. Bugbee in his paper, it is impossible in a brief discussion to do more than select a few of the high points and comment thereon.

Dr. F. Warner Bishop: Dr. Bugbee's clear-cut and concise presentation of a most important phase of urological work represents more than just a scientific paper. To one who may read between the lines there is to be seen the great triumph of modern urology. For there is no branch of medicine or surgery in which diagnostic methods are so highly developed. The instruments used here are truly instruments of precision and the accuracy of the observations is not to be matched in any other specialty with the possible exception of ophthalmology.

Thanks to the consummate skill of the urologists we poor humans may now have relief from the most painful and dreaded maladies. We now no longer need feel as did Pliny when he wrote, "There are three sorts of diseases to escape which a man has a good title to destroy himself; the worst of which is the stone in the bladder when urine is suppressed." And in this day of cystoscopic enlightenment when a man is "seen to urine black, thick, and frightful water or to have it suppressed by some sharp and craggy stone" he need not fear as did Montaigne in the fifteenth century that operation for the stone would be in a place where the stone was not. Montaigne tells us of "a bishop who was my particular good friend" who underwent the operation. "And when he was dead and opened the stone was not in the bladder but in the kidney."

In discussing Dr. Bugbee's paper there is little I can add, and nothing I can criticize. Perhaps, however, there are a few of his words I can emphasize. Of course, we all realize that elimination of the products of catabolism is the all-important consideration in safe-guarding the post-operative urological patient. And here water is our chief indication. The quantity which may be safely used by the various methods of administration is much under discussion, but I feel that there is little danger of over-loading the circulation by amounts up to 4 or 5000 c.c. per day, so long as we do not introduce more than 1000 directly into the circulation. A few fearless surgeons are now giving 7 or 8000 c.c. a day by slow infusion in cases of shock without apparent damage, but many urological patients are elderly and often have a marked degree of chronic myocarditis and I should be fearful of such heroic hydration.

The lazy or distressed colon throws its load upon the kidneys. Scrupulous attention to the intestinal elimination is essential after operation. This will mean for a time colon irrigations, enemas, cathartics. But let us, as soon as the emergency is over, try to re-educate the bowel to take up as nearly normal function as possible without the use of drugs which keep up a chronic colitis. This means cooperation on the part of the patient without which the colon remains an absorbing surface for bacteria of all varieties which are hurled through the circulation at the embarrassed kidneys. Let me repeat: stop cathartics as soon as possible. Resort to diet, regular habits, and bland preparations of agar, psyllium seeds, or mineral oil.

As to postoperative bleeding, I feel that I would like to leave with you one definite conviction. Aside from directed ligation of a vessel or pressure upon it, there is no hemostatic known which is so reliable as direct transfusion of blood. Continued bleeding is the indication. We should not wait for a reduced hemoglobin or red cell count.

The true indications for digitalis are decompensation of the heart with edema and dyspnea and many internists feel that in the absence of these digitalis is useless. This attitude however, is a bit modern and many of us are still old-fashioned enough to think that small doses given daily over long periods are a great help to the chronic cardiac.

And may I add in closing a most important form of treatment for sufferers from chronic disease: every ounce of moral support and comfort that we physicians can give.

Dr. N. P. Rathbun: Perinephritic abscesses do occur occasionally entirely irrespective of any kidney lesion. There is no reason why we should not have an infection in the perinephric fat resulting from a focal infection in the teeth or tonsils in the same way that we may have a similar infection in one of the bones of the leg. The diagnosis of perinephric abscess is sometimes very difficult. Like Dr. Beer, I have seen some cases with a long history. One patient who came under my care several years ago had been suffering for two years with pain and vague discomfort in one loin and had been studied carefully in several hospitals. There was no elevation of temperature and no leucocytosis but he did have a huge tender mass in his right loin. We finally made a diagnosis of renal tumor and started out to do a transperitoneal abdominal nephrectomy. Fortunately, before

getting into the peritoneum we opened into a large cavity, evacuated about a quart of pus and the patient went on to a smooth recovery.

Dr. Bugbee's subject is extremely practical; for the cure of such patients depends as much on the after care as on the skill of the operator. I have often said that though you can teach an interne to take out a prostate or kidney in a short time, it takes not only knowledge but wisdom to understand the proper after care. Many of us have noticed that our private cases do rather better than our ward cases. We attempt to see that the latter do have proper care, but details are left to the care of the internes; whereas our private cases have our personal supervision, and we are rewarded for it.

I will speak on only one or two points of Dr. Bugbee's paper, first, the question of bleeding after prostatectomy. I have not quite the faith in the large tube that Dr. Beer has. Recently I sent a man back to the ward with one of those hairpin arrangements which keep the bladder more widely open than with a large tube. The man left the operating room with no bleeding, but several hours later bled profusely and died despite all that could be done, including packing and transfusion. I use gauze and pack in nearly all cases. One of the things that is very important about packing is the time and manner of its removal. One of the men spoke about a patient dying after the pack was removed. It should be removed very carefully and slowly and if it sticks it should be taken out later and removed gradually if necessary.

I think the resection of the vas is almost absolutely preventive of epididymitis. For the last two or three years I have been doing a vasectomy routinely and I have not had a single case of epididymitis since.

If suprapubic prostatectomy cases are not voiding after two or three weeks, I believe there is still some obstruction and such cases should be cystoscoped. Very often we find a little tab which should be removed by a punch or fulguration. Those that heal slowly are due to some obstruction at the bladder neck.

One of the complications that Dr. Bugbee said nothing about is very important; that is toxic psychosis. Most of these cases are not very serious, and many patients following a prostatectomy have a mild psychosis and get well; but I have seen some very ill, and one or two have died as a result of wear and tear on the system, and exhaustion. It is a subject about which we have a good deal to learn. I have always thought them perhaps due to some unknown factor, possibly a mild sepsis, or a mild degree of uremia not expressed in the terms by which we usually recognize it. The patient may have normal urea, creatinine, etc., and yet be uremic. Of course in all these patients we have a background of cerebral arteriosclerosis. In many cases there is a mental background, etc. In some instances possibly a lowering of the blood chlorides has something to do with this problem; I have checked that up and found it so in some cases. It is a very mysterious subject and worthy of further study.

The question of lithiasis and the importance of after care: I heartily subscribe to what has been said about proper urinary drainage following the removal of calculi. I believe that cases after the removal of renal calculi should be followed for some time, and treated with irrigations, ureter dilatations, etc., and repeated *x*-ray pictures.

I also heartily subscribe to what was said about the care of the urinary tract in tuberculosis and the postoperative hygienic care. When we have done a nephrectomy for renal tuberculosis, we have only started the treatment.

Carcinoma of the prostate: In all my cases I do a suprapubic cystotomy, certainly where there is much retention and even where there is very little or none. I think such patients get along very well with their suprapubic tubes, live longer and more comfortably. I also employ radium either through the bladder or through the perineum.

Dr. Oswald S. Lowsley: I heartily subscribe to most of what Dr. Bugbee has said. Each of us has his individual preferences in small things, otherwise there would be no individuality or personality. The after care of the prostatic case is a particularly interesting subject. I understand that when a physician discharges a patient who has had a typhoid fever he prescribes a three months' period of convalescence. I think we should likewise, in the average case after prostatectomy, prescribe a *six months*' period of convalescence. If the patients will take a complete rest for as long a period of recuperation as possible they will make a better ultimate recovery than if they attempt to resume business too soon.

The after care of calculous cases interests us very much. We have had some very interesting experiences. One case of which I have spoken before we have followed for ten years. The patient was entirely relieved of calculi. In the one remaining kidney, by changing the reaction of the urine from alkaline to acid and by keeping it changed the patient has had no recurrence since, whereas she had been operated on five times by me previously and twice before I saw her.

The question of the postoperative care of tuberculous patients is very close to us. We have a clinic devoted to that purpose, and Dr. Rathbun said just what I think, that when the operation is over the work of the surgeon has just begun. We have allied with ourselves Dr. Wang, who is familiar with pulmonary tuberculosis and has been very helpful to us in caring for these chronic urological cases. We hold the clinic twice a week and run parallel cases of patients treated with tuberculin and others treated with only hygienic measures. Drs. Dalzell and Wang are doing excellent work in this clinic.

Concerning Dr. Taylor's presentation: It seems to me that perinephric abscess can present a greater variety of symptoms than any other lesion we meet in urological surgery. I have cases with a history of nine years standing: a woman had her first febrile attack with pain in the side nine years before I saw her. Later she had a similar attack which lasted for some months. The pain was felt in the uppermost part of the right upper flank; she had some lung symptoms also; she then had a third attack two months before she saw us. Investigation showed that the ureter was obstructed at the ureteropelvic junction. On operation we could trace these three different cycles in her history. One palpated a cavity, and as this was explored a diverticulum-like orifice was found above and a cavity extended up under the diaphragm. A great amount of pus was evacuated and then another similar cavity extended below into the pelvis. She had formed a sac and protective wall which broke out on two occasions in two different directions.

Dr. J. S. Read: I wish to pay my tribute to the valuable help received from Dr. Bugbee's paper. In the two-step operation there is an increasing tendency to remove the prostate, nine or ten days after the cystotomy. Within a month I have seen 2 cases, in which there has been severe hematuria and shock, which could have been avoided if a longer period between operations had been allowed. Has Dr. Bugbee any minimum time limit between operations?

Dr. S. R. Woodruff: I was much interested in Dr. Taylor's description of a case of perinephritic abscess, and that he quoted one surgeon as saying that all such conditions were caused by cortical abscess of the kidney. It is difficult for me to believe this. My personal experience with perinephritic abscess is that one sees two varieties. The usual type is the one that comes on so slowly and with such indefinite symptoms that the urologist is not consulted until several weeks have passed. The patients usually have little or no urinary symptoms, and we are called upon for our opinion because of the pain in the back. The urologic work-up of such a condition usually shows an excursion of the kidney from its normal position and its shadow much obscured. The function is frequently delayed, but found normal upon the passage of a catheter to the renal pelvis. Pyelographic study usually reveals the kidney to have been pushed out of its normal position and frequently rotated upon either axis. There is usually no demonstration of kidney involvement in this condition. The other type of perinephritic abscess is associated with a cortical abscess which breaks down and ruptures into the perirenal space. It is usually associated with high temperature, severe pain and more or less toxemia. It is difficult for me to reconcile the statement that a perinephritic abscess is always associated with a renal abscess because in my own experience where I am unable by the ordinary urologic study to determine renal involvement, and at operation large perinephritic abscess is found, I am content simply to open the abscess cavity and supply adequate drainage. Unless one delivers the kidney for actual inspection, I do not see how the presence or absence of a renal abscess could be proved, and my personal judgment is that such a procedure is somewhat unjustifiable in the presence of a large abscess.

Dr. Bugbee's paper is of great value. We all need to check ourselves up on operative and postoperative work. I find the postoperative treatment varies to no great degree amongst urologists of today. In the two-stage prostatectomy, actual visualization of the prostatic bed is nearly impossible, and I have employed

for some time direct pressure with a mass of gauze held by the fingers of one hand, and pushed into the bleeding area from which the prostate has been removed. As in practically all two-stage operations one or more fingers are inserted in the rectum to lift the prostate up for better enucleation, direct counter pressure can be made against the rectal fingers and bleeding by this means usually controlled.

Dr. John A. Taylor: After a review of the literature one is almost forced to conclude that perinephritic abscesses come from cortical lesions in the kidney. The largest series of cases has been reported from the Mayo Clinic. Braash reported 67 cases in 1915, followed in 1924 by Dr. Hunt, who reported 59 cases; and Habein reported over 44 more in 1928, making a large series of cases of perinephritic abscesses. These cases were all reported with the idea in mind that perinephritic abscesses come from cortical abscesses. The most convincing was Dr. Hunt's article in 1924—106 cases; of these, 59 were the so-called perinephritic cases; 28 of these were explored at the time of operation; 5 had nephrectomy; these 33 cases, all that were able to be investigated, all had cortical lesions in the kidney on the affected side. It does seem to me from an etiological standpoint that the logical path of infection is through the kidney, for the kidneys are the sewers of the body that would try to throw off foreign bodies from the blood stream. It seems more logical for abscesses to form, following perinephritic abscesses, in the renal cortex than it does that they should form in the avascular fatty renal capsule.

Dr. Henry G. Bugbee (*closing*): As for the case of the single kidney with tuberculosis: the woman had typical tuberculous lesions in the bladder, had no left kidney; the urine from the single kidney contained a large amount of pus with many tubercle bacilli. The pyelogram also showed the characteristic necrosis of tuberculosis. She had tubercle bacilli in the urine for four years, but for the last ten years, the urine has shown no tubercle bacilli. I believe that when tuberculosis of the kidney is diagnosed and a healthy kidney is revealed on the other side, the diseased kidney should be removed. In this case, however, one sees the possible reparative power of the body. A pyelogram taken seven years ago showed considerable destruction of kidney tissue, but the areas of necrosis were well walled off.

Dr. Rathbun spoke of postoperative psychosis. I have noted this as a rare postoperative complication, and it is a distressing one. I have always thought it to be due to a combination of uremia, poor circulation, and sepsis.

Dr. Read asked about the length of time allowed to elapse between cystotomy and prostatectomy. The second operation is not carried out in less than two weeks after the primary cystotomy. The exact length of time between the two operations varies with the individual case; the longer the interval, the less pronounced will be the reaction following the prostatectomy.

PROSTATIC HYPERTROPHY*

ITS SURGICAL TREATMENT

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THOMPSON states that of men who have reached sixty years of age, 34 per cent have enlarged prostates but only 16 to 17 per cent of the whole are affected by symptoms. So about half of the enlarged prostates give symptoms. The prostate is purely a sexual organ and likely passive regarding urination; however, the symptoms of prostatic disease are predominantly urinary.

The cause of hypertrophy is unknown. Most writers agree that the enlargement is due to fibroadenomata much like those found in the mammary gland. The cause of fibroadenomata wherever found is unknown.

The family doctor sees these cases first. An old friend perhaps whom he has attended with his wife and children for years comes to him for counsel. He states his urinary trouble in a hesitating manner rather ashamed to confess that he must be growing old. The family physician holds a very important position as to the future of this man's life. If his advice is good he will carry him over this serious urinary event to future good health; but, if on the other hand, his advice is wrong he may lead him into a miserable existence, and eventually death from pyelonephritis.

The advice to the prostatic should always be surgical treatment. There is no other treatment worthy of consideration. The so-called catheter treatment is always lethal. When I look back over more than twenty years of surgery there is no class of patients more grateful to me than my old prostatics, and no operation has given me more satisfaction than that of prostatectomy.

In this paper we shall consider only simple prostatic hypertrophy, i.e., the adenomatous type of hypertrophy.

The prostate is located in the neck of the bladder partly urethral and partly intravesical. It may be described as the shape and size of a large horse-chestnut with the apex in the urethra and the base in the bladder. The urethra and the ejaculatory ducts perforate the prostate. The important Denonvillier's fascia separates it from the rectum posteriorly and extending anteriorly forms the puboprostatic ligaments. Besides this sheath it has a definite thin capsule of fibrous tissue which dips into the parenchyma, forming lobules. The parenchyma is composed of glands of the compound racemose type with a stroma of non-striated muscle tissue. The secretion is poured into the lateral portion of the floor of the prostatic urethra. The prostrate has two lobes known as the right lobe and the left lobe. These lobes are not distinct excepting in hypertrophy. The pathologic middle lobe originates in the glands of Albarran in the floor of the prostatic urethra. The hypertrophy is due to fibroadenomata growing within the gland. Surrounding the fibroadenomata is a false capsule of normal prostatic glandular tissue. The word prostatectomy is a misnomer because the entire prostate is not removed. The only portion removed is the pathologic fibroadenomata. An adenectomy within the bladder would more properly describe the operation. This is why sexual function is rarely impaired by prostatectomy. There should be always enough normal prostatic gland left behind to function adequately.

The prostate lies on the rectum and is readily accessible to palpation by the finger. It is very rich in blood supply, and thereby accentuates hemorrhage as being a possible complication in prostatectomy. As a matter of fact hemorrhage

* Read at a meeting of the Crawford County, Pa., Medical Society, Oct. 15, 1930.

is the predominating cause of the mortality in this operation. Hemorrhage is mostly venous. The prostatic plexus of veins is imbedded in the fibrous sheath of Denonvillier. These are found around the anterior portion and laterally posteriorly of the gland. The thin true capsule separates these veins from the glandular structure. Besides the prostatic plexus of veins there are veins in the urethral and vesical parts of the gland. Sometimes all these veins are varicosed. The dorsal vein of the penis and the vesical veins empty into the prostatic plexus, and all may communicate with the hemorrhoidal plexus posteriorly. The prostatic plexus joins into a single vein on each side and empties into the internal iliac vein.

Arterial bleeding is usually caused by the incision in the capsule; therefore with a good exposure the spurting artery may be caught in a hemostatic forceps quite readily and tied. Venous hemorrhage can be controlled by packing because of the low blood pressure in the veins; consequently to be free of serious hemorrhage demands delicate and skillful surgery. If the surgeon keeps within the false capsule during the enucleation of the adenomata bleeding will not be excessive. Fatal postoperative hemorrhage is possibly always caused by rough handling during the enucleation, thereby lacerating the prostatic plexus.

The symptoms of prostatic hypertrophy vary much with each individual. It would take much space, indeed, to record all the symptoms referable to this affection; however, this is not feasible in this paper, nor is it essential.

Keyes notes briefly a triad of common symptoms that are almost pathognomonic, which will do quite well for a working outline, namely: (1) frequency of urination, chiefly by night, (2) difficulty in urination and (3) dribbling from overflow, or irritation of the bladder.

There is usually nocturnal polyuria with frequency and as the night wanes the frequency is increased. The night's rest is very much disturbed. Urination becomes difficult, the stream is slow to start, the flow lacks force and there is no gush at the end of urination. The urine dribbles and drops. If the patient gets wet or cold or bathes in cold water, or is indiscrete in diet, he may not be able to void at all. He suffers from acute retention. Dribbling is a source of great discomfort. Of all the symptoms this one is the worst. It may be due to overflow from the chronic retention or simply irritability of the bladder. The prostatic may pass slight amounts of blood at the end of micturition. The early irritability of the hypertrophied prostate may lead to priapism, to a return of the morning erection, and also, to moral obliquity. Epididymitis, cystitis, pyelonephritis and vesical stone may complicate prostatic hypertrophy.

The commonest cause of prostatic disease in a man over forty-five years is prostatic hypertrophy. When a patient, aged forty-five or more consults a physician with a history of Keyes' triad of symptoms he should suspect hypertrophy of the prostate.

The first step of the examination is palpation of the prostate through the rectum. This at once may confirm his first impression. He will fail if only there is a median lobe enlargement, otherwise he will gain a very good idea of the prostate.

Secondly, he will palpate the hypogastrium for a full bladder. It is well for him to replace the finger in the rectum and palpate between the two hands. Then he will have the patient void in a glass. This will give him information as to the difficulty of urination and as to the flow of the stream. This urine should be chemically and microscopically examined. It is best to send the urine to a laboratory equipped for complete urinary tests.

The patient then should lie down to have a catheter passed. It is best to use a small size, linen catheter with a Coudé' tip. The amount of residual urine is measured, the atony of the bladder determined,

length of the urethra, etc. The physician will gain a great deal of information. The catheterized specimen should also be sent to the laboratory. If the bladder should contain a pint or more residual, it is wise when the bladder is irrigated to leave in the bladder at least half as much solution as urine drawn out. Some very bad results have followed rapid decompression of a highly distended bladder.

Cystoscopy should only be done by a trained man in this work. We never cystoscope these patients outside of the hospital. When you have gathered your data you should be able to diagnose the case at least tentatively as one of prostatic hypertrophy requiring surgical relief.

This examination will about exhaust the average physician's training in genito-urinary surgery. Of course, the expert urologist will readily differentiate simple hypertrophy from other prostatic pathology by methods not within the scope of this paper.

Cases of acute retention complicating prostatic hypertrophy are usually seen first by the family physician, or some other physician living in the neighborhood. These calls are not infrequent and every family physician should be equipped with the instruments to take care of these old men properly. Metal catheters should be tabooed. A good linen catheter No. 18 F. with a Coudé tip, and also, a Phillip's linen catheter with filiform attachment will be sufficient to relieve all cases of acute retention due to prostatic hypertrophy. Surgical removal of the enlarged prostate should be urgently advised.

The preoperative preparation is most important and may determine success or failure of the prostatectomy. These patients are usually in the evening of their lives, therefore senility probably participates in every function. The surgeon must not only be a good operator but he must also be a good physician.

On the admission of the patient to the hospital a general physical examination is made. The cardiovascular system is carefully measured and considered. The hypertensive cases have an eyeground examination by an oculist. A blood count, urinalysis daily, and phthalein test are made; also blood chemistry for non-protein nitrogen and sugar. It is surprising how frequently we find a hyper-glycemia where least expected. The patient is given 8 pints of water daily and the output measured. Many of these cases require digitalis. After a forty-eight hour rest in the hospital the bladder is examined with a cystoscope to complete the diagnosis and later, perhaps the same day, a cystotomy under regional anesthesia is performed.

The bladder is filled with normal salt solution, and then opened and carefully palpated for stones. If stones are present they are removed. Two silver wire sutures for coaptation are placed through all the tissues including the bladder walls. A large Pezzer catheter 40 F. in size is inserted for suprapubic drainage of the bladder and the incision closed with the wire sutures. These wires are left long and the ends covered with adhesive plaster so that they will not catch on the dressings.

The second step of the operation, or the actual prostatectomy, is done when the surgeon believes the patient can stand it. We have found it to be helpful to have a good medical practitioner associated with us in the surgical treatment of these cases.

The phthalein output usually increases under drainage and the non-protein nitrogen comes down. We like the non-protein nitrogen to be below 40 mg. per 100 c.c. of blood before operation. If the non-protein nitrogen remains high we do not operate. Sometimes the patient cannot, or will not, take the required amount of water. In this case we pass a duodenal tube at 9 o'clock in the morning and leave it in the duodenum until 12 noon, in the meantime giving the necessary amount of fluid, 8 pints, through the tube. This is done daily. It is rarely we are compelled to do this. We routinely give 30 grains of hexamethylenamine in a tumbler of water

in the morning and 30 grains of triple bromides in the evening. The diet depends entirely on the conditions found. The patient is allowed to sit up at will. The bladder is flushed with boric acid solution through the Pezzer drainage tube daily. The average preoperative preparation is fourteen days. So far every patient referred to us has been operated on. That means that all of them had responded sufficiently well to the preoperative preparation, that we were able to do the prostatectomy. It does not mean, of course, that we had cured his extrinsic pathology before operation. Since we have stopped using inhalation anesthesia we have observed that patients suffering from hypertension, or emphysema or cardiovascular diseases do very much better. Our greatest problem is kidney dysfunction due to pylonephritis.

Two hours before the operation the patient is given 6 grains of sodium amytal by mouth. We use caudal and trans-sacral anesthesia with regional anesthesia in the suprapubic region, or we may use a low spinal of 100 mg. of neocaine in the third lumbar spinal interspace. Lately we have been using more spinal anesthesia.

The bladder is flushed through the Pezzer catheter with warm boric acid solution, and the catheter and silver wires removed. The suprapubic opening is enlarged and a self-retaining bladder retractor inserted. This gives a good exposure of the operative field. A soft rubber catheter is passed into the bladder through the urethra and connected with an irrigator.

The bladder is once more flushed with warm boric acid solution from the irrigator and at frequent intervals during the operation. The operator puts a glove on the left hand and none on the right hand. The left hand is placed in the rectum with fingers pressing on the prostate. With his right hand in the bladder he pushes his index finger into the urethra and splits the mucous membrane with his finger nail posteriorly. He then shells out the prostate using the index and middle fingers. The fingers in the rectum are very important because they steady the prostate and give the operator a proper sense of thickness of tissues, and also, aid in the completeness of the operation. No cutting instruments of any kind are used in the enucleation of the fibro-adenomata.

After the prostate is thoroughly loosened it is caught by Young's prostatic forceps and removed from the bladder. The prostate may be removed in one piece but usually it is in several pieces. The operator should be careful to loosen every part of the prostate with his fingers before much traction is put on the prostatic forceps. The hand has remained in the rectum all this time, and once more the prostatic capsule is palpated with the right hand to remove any small pieces of the adenomata left behind. The bladder is flushed with borid acid solution quite warm, 110°F., and any spurting arteries are caught in hemostats and tied with catgut by the assistant. To stop the venous bleeding the capsule is tightly packed with iodoform gauze in one long strip 2 in. wide. The gauze extends out through the wound. Now the finger is removed from the rectum, the glove removed from the left hand, the hands cleansed and fresh gloves put on. Inspection of the bladder is made for bleeding and closure begun. The upper part of the bladder incision is closed with a running suture of fine catgut. The fascia is brought together about halfway down with chromic gut and the skin for a like distance with silkworm gut. Two silver wire sutures are placed as described in cystotomy and are loosely brought together. A final irrigation is done and the urethral catheter removed. Large dressings are applied and the patient returned to a warm bed.

In the postoperative treatment it is important to keep the patient quiet and comfortable. Morphine is usually required during the first twenty-four hours. We continue the hexamethylenamine and triple bromides as we did in the preoperative preparation. We continue the water in large quantities, i.e., 128 oz. in twenty-four

hours. We give fluids by vein as we do in other surgical postoperative cases. We may give normal saline by hypodermoclysis the first day; after that we give plain water by mouth or through the duodenal tube. The gauze packing in the bladder is removed within seventy-two hours, and a large Pezzer catheter is inserted in the bladder and connected up with a drainage bottle. The silver wires are drawn up tightly around the drainage tube. After the gauze packing is removed and the suprapubic drainage tube placed, the urine is all carried off into the bottle, and there is practically no leakage. We try to get the patient out of bed on the third day; thereafter, he sits up a part of each day. The bladder is flushed daily through the drainage tube with a mild mercurochrome solution. The silkworm gut sutures are removed on the eighth day.

About the fourteenth day a large urethral catheter is passed and fixed to the penis by adhesive tape and connected up with a drainage bottle. The suprapubic drainage tube is removed and the wound drawn tightly together with the silver wire sutures. The bladder is still being flushed daily. About the twenty-first day when the suprapubic incision is healed the permanent catheter is removed, and then passed once daily to flush the bladder. All sutures are removed from the suprapubic wound and usually by the twenty-eighth day the patient is healed, voiding rather frequently and ready to go home.

The follow-up treatment should be continued for about one year after the operation. This we believe to be important. Weekly, or later bi-weekly, bladder irrigations and an occasional urethral dilatation with a metal sound of large caliber improve the results of the operation very much.

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*Continued from p. 14.

THE SEXUAL FACTOR IN PROSTATIC HYPERTROPHY*

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THUS far, all theories which have sought to explain the causation of benign hypertrophy of the prostate have proved to be unsatisfactory. None of the theories have been founded on sufficient data to enable them to account but for a very small number of cases. Schools of thought which seemed almost irrefutable yesterday and were generally acclaimed, today have been disproved and discarded. Though our technique for the surgical removal of the prostate has reached a high degree of perfection, yet little advance has been made in recognizing the cause of the malady or a means of preventing it.

One very significant contribution to the problem of prostatic hypertrophy was made by Kenneth Walker in 1922 in a paper entitled "Nature and Cause of Old-Age Enlargement of The Prostate." In this article, he presents a panoramic view of the prostatic problem and calls attention in particular to the variation in the incidence rate of prostatic hypertrophy among the various races. He points to the rarity of the malady among certain people and seeks to ascertain the reason. If prostatic growth is a disease of the white man what is there in his mode of living that is conducive to it?

The survey of Walker and corroborated by that of Pfister, indicates that prostatic enlargement is less common amongst the inhabitants of Japan, China, Philippines, Egypt and Africa. Here are some of the important facts as elicited by the questionnaire sent by Walker to surgeons of the various races. India: Prostatic enlargement less common than in England. Japan: Prostatic enlargement is very rare. Dr. Matsumato reports that in the records of the out-patients' department of the special Hospital for Urinary Diseases at the University of Kyoto there is an average of 4 cases of enlarged prostate per annum, although the total attendance runs into several thousands. Prof. Hyami of the same university has never encountered the condition on the dissecting table. Kitagawa and Takagi also vouch for the rarity of the condition. China: Dr. Koch, of the Government Hospital at Hong Kong, states that during the last fourteen years, no case of enlargement has been seen, although the yearly average of in-patients is 4000, and of out-patients 25,000. In the Canton Hospital records for the years 1915, 1916 and 1919, there are 3 entries of prostatic enlargement, although during the same period as many as 156 cases of vesical calculus are recorded. During the years 1910 to 1919, 13,761 operations were performed in this hospital, of which 6 were prostatectomies. Egypt: Not uncommon but less so than in England. At the Kasr-el-Ainy Hospital, Cairo, there were 17 cases of prostatic enlargement in 1921 out of a total of 8472 male in-patients. Pfister, who for many years was a physician in the Deaconess Hospital in Cairo, was impressed by the rarity of the condition in Egypt and believes that it is all the more remarkable because infection of the bladder and prostate by bilharzia is rather common in this country. Milton, Goebel, Kartubis, Madden and Legrand have made similar notations. Philippines: J. M. R. Dill writes, "Has hypertrophy of the prostate ever been observed in old people here in this country? Certainly never in the great number of patients in the Philippines General Hospital in Manila." South Africa: Medical men are of the unanimous opinion that enlargement is extremely rare amongst the natives of South Africa. It must, however, be taken into consideration that few natives live beyond the age of fifty. North America: The incidence amongst the white is similar to that of England but the affection is rather rare amongst the negroes. Of course the question immediately arises, "Is the comparison fair?" In all likeli-

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hood the average negro does not live as long as the average white, and the negro thus afflicted does not seek medical aid as readily as the white. Nevertheless, the majority of American urologists agree that the condition is rare amongst the negroes. As a result of this study Walker believes that prostatic enlargement has an anthropological distribution and according to frequency classes the races thus: Caucasian, Semitic, Arabic, Indian, Mongolian and Negroid.

Now those countries in which prostatic enlargement is rare, are the very places in which the sexual life is rather unrestricted. This then disproves the theories once held that sexual excesses or attacks of gonorrhea predisposed to prostatic enlargement, for those races which are comparatively free of the condition are the very races not known for their continence. What then, is there about the sexual life of the Caucasian which predisposes him to prostatic hypertrophy? Is this form of tumor the price he pays for so-called higher morality? Why should the celibate clergy escape it? Why should married men be particularly subject to it? What is the relation between the sexual life and prostatic overgrowth? These and other questions germane to the matter need to be answered, and it will be only by a proper piecing together of our many bits of fragmentary knowledge that we ever will, in all likelihood, be able to solve this perplexing riddle.

When a man enters the fourth decade of life he is encroaching on the prostatic danger zone, for it is during this period that the prostate begins to trouble the male sex. Why should the male at this critical period, the old age of youth, begin to manifest prostatic disorder? Now, it has been rather conclusively shown that the indiscretions of youth bear no definite relationship to the formation of prostatic tumor for many prostatics have never had gonorrhea and most gonorrhoics are never bothered with an enlarged prostate. In fact, many urologists are of the opinion that a severe gonorrheal infection is inclined to render a man immune from prostatic overgrowth. It is then not man's past which rises up to admonish him for his earlier misgivings, it is he who possesses a large boggy prostate who becomes the candidate for prostatism and perhaps ultimately for its surgical removal.

Every urologist knows that if a man leads a normal sexual existence and then suddenly ceases to have indulgence, his prostate will become congested, frequently giving rise to urinary disorders. When such a case presents itself, we find on rectal examination a large tender prostate. On massaging of such a prostate, we can usually express a copious quantity of prostatic secretion together with the products of inflammation. Relief of symptoms and reduction in size attend such an artificial evacuation and therefore we logically assume that when such cases are medically managed there is little likelihood of a surgical prostate developing. Recently Ballenger, Elder and McDonald have reported a very significant observation in the matter of preventing benign enlargement of the prostate. They noted in their practice that there were no cases of prostatic hypertrophy occurring among their patients who were periodically masaged. The group included males between the ages of forty and sixty-five. They reason, and I believe rightly so, that a mild irritating toxin produces the hyperplasia and that by massage the toxin is eliminated. Van Lackum and Mitchell were also able to obtain excellent results in the so-called bar obstructions, by routine massage, instillation and dilatation.

Prostates become disordered during the period of the male sexual crisis, unless they are unloaded of their contents either in a physiological or mechanical manner. The process is somewhat as follows: The gland normally secretes a substance essential for activating the spermatoza. During sexual excitement the muscular tissue of the prostate contracts and forces this secretion into the urethra. Now when there is a sudden abatement of sexual activity, the prostate becomes congested

and swells because there is an accumulation of secretion. And so, even though a man may feel that he may safely abstain from sexual activity, physiologically he cannot and the penalty for his defiance of the natural law is prostatic trouble. Beer has stated, "The etiology of prostatic adenoma is not understood, but it would seem that the irritation associated with sex activity whether gratified or not, may underlie the condition."

We do know that a goodly number of men radically alter their sexual conduct on entering the middle span of life and practice sexual abstinence. The underlying motive is not always ascertainable. Some men feel that a celibate existence constitutes the ideal life; others that sex is something the sensible man should put out of his life after he has entered the years of discretion. Not a few men think that by foregoing sexual activity they will conserve their energy, that sickness will not befall them and longevity is thereby assured. A continent life is forced on many men because their spouses are ill or frigid, or their libido may be inhibited by financial or business worries or psychic impotency. Cases such as fall within this category are very apt to manifest the urinary symptoms associated with an inflamed prostate and unless their prostate is depleted by massage or an equivalent measure, the gland will continue to gradually enlarge and cause its customary phenomena. Though we no longer consider Ciechanowski's view that hypertrophy is a sequelae to gonorrheal prostatitis, we cannot deny that the inflammatory process does play a part in initiating the proliferation of the glandular elements.

I have previously called attention to the statement made by Young that the celibatic clergy are practically immune to prostatic hypertrophy. In this group the prostate never develops into an actively secreting gland because at a very early age the sexual life was abnegated and the prostate accordingly was never called into activity as it is in the normal married man. Celibacy adopted late in life is therefore not a preventative but rather an accelerative of prostatic enlargement.

Dovetailing perfectly with our foregoing data is the work of M. Roth, Director of the Pathological Institute at the University of Basel, who has carried out a pathological and histological investigative study of 300 prostates in men varying from thirty-six to ninety years. He found some evidence of prostatic hypertrophy in 101 cases (approximately 30 per cent) and this was exclusive of inflammations and malignancies. His findings are as follows:

		Prostatic Hypertrophy
Years	Cases	Per Cent
36–40	51	7 or 13
40–50	91	23 or 25
50–60	64	20 or 31
60–70	55	31 or 56
70–80	28	14 or 50
80–90	11	6 or 54

Of course it is not to be inferred that a man with a small spheroid in his prostate at forty is ever going to manifest gross hypertrophy of the gland any more than a small fibroid in a uterus will of necessity develop into a large one. But, I do wish to emphasize the point that prostatic tumors do not spring suddenly into existence during the fifth and sixth decade. Prostatic hypertrophy has its incipiency between forty and fifty and only becomes bothersome when certain conditions either in the sexual life or in the endocrine system promote the formation of spheroids.

SUMMARY

It is the intent of this study to explain the frequency of prostatic hypertrophy amongst the Caucasian race. I do not believe the difference lies in an anthropological or geographical basis, but rather in the main because of our cultural code which tends to repress the natural outlet of sexual energy. Prostatic congestion is the price often paid for ignorance regarding the physiology of the sexual organs. The most logical method of preventing prostatic hypertrophy is periodic massage of the congested prostate or a vita sexualis which is compatible with the age, inclination and general welfare of the patient.

[For References, see p. 55.]

MANAGEMENT OF PATIENTS SUFFERING FROM PROSTATIC OBSTRUCTION*

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THE last twenty-five years have seen a most gratifying progress in the management of prostatics. Two decades ago patients who were admitted to the best hospitals because of acute retention due to prostatic obstruction could be given little more than a choice between early death, or lingering to endure almost ceaseless suffering. The surgeons and the procedures characterizing the period of time which has since intervened are striking examples of the wonderful progress made.

There are today three recognized methods of approach to the prostatic problem. To these we wish to add a fourth. (1) A one-stage suprapubic enucleation may be done, after preliminary drainage via the urethra; (2) a two-stage suprapubic prostatectomy may be carried out after cystotomy; (3) the gland may be removed by the perineal route, with a one-stage procedure, drainage being maintained by the perineum.

The objection to the first listed, the one-stage suprapubic method, is the high mortality rate which attends it. While accurate reports regarding all such operations would be impossible to obtain, it seems likely that the mortality reaches as much as 25 per cent. By the employment of preliminary drainage through a cystotomy opening, this rate can readily be reduced to 10 per cent. Another drawback to this procedure is the time it requires for complete recovery. The perineal operation gives good results in much less time and cuts the mortality rate in half, or even lower, if performed by skilful hands. But on the other hand, the perineal operation is a more difficult surgical feat, and the epididymitis and fistulae which sometimes follow, are exceedingly distressing sequelae.

It is our intention to describe a *two-stage perineal method* offering advantages found in no other of these procedures.

Selection of Patients: This operation is so benign that a man fit to undergo any major surgical procedure can by its employment be relieved of a most distressing condition, without incurring undue risk.

Preliminary Management: Patients with enlarged prostate usually enter the hospital only after acute retention has taken place. It is our practice to give sodium amytal immediately, in doses sufficient to relieve suffering. A very gentle attempt to pass a soft rubber catheter is then made. If this fails a cystotomy is done at once under local anesthesia. At the same time the bladder is explored and the configuration of the prostate noted. If a loose stone chances to be present it is removed. A 32-French Pezzer catheter is sutured in the bladder, the wound irrigated with 1:5000 metaphen solution and closed without drainage. The urine is kept antiseptic by the administration of suitable doses of pyridium, thus obviating the disagreeable odors often given off after cystotomy has been done. The bladder is irrigated several times a day with the 1:5000 metaphen solution.

After ten days to two weeks of such preliminary medical attention, observing all the necessary precautions, we remove the prostate by the perineal route. The cystotomy tube is not disturbed and the bladder is not drained by way of the perineum.

Anesthesia: Spinal anesthesia with sodium amytal base has proved very efficient in our work. The dosage of spinal anesthesia is so small that any chance of untoward effects is done away with, and it induces an ideal relaxation.

Technique: The patient is placed in the

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lithotomy position and the perineum elevated. No special table is necessary. Several sounds are employed to dilate

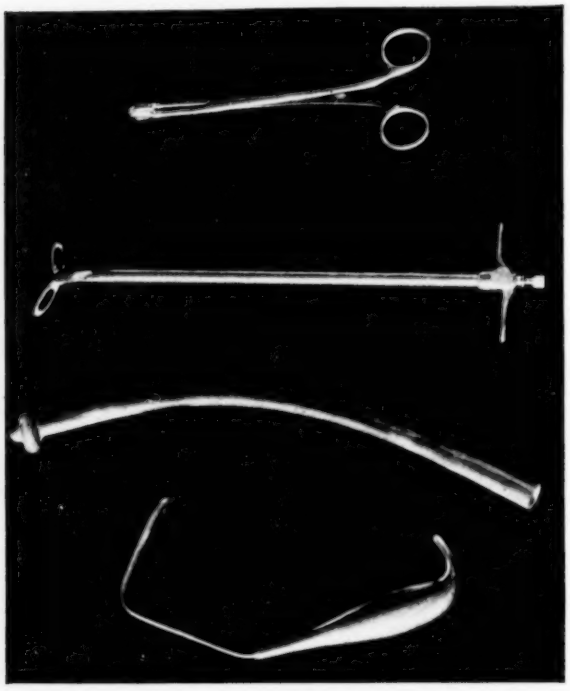


Fig. 1. A. Proust retractor. B. Pezzer catheter. C. Crowell tractor. D. Vacher clamp.

the prostatic urethra, and a Crowell tractor passed into the bladder. This retractor has so reduced the difficulties of this operation that it must be listed as one of the major contributions to the advance in treating prostatic conditions.

After the prostate has been pulled down forcibly in the perineum and the scrotum pulled up over the abdomen, an inverted-v incision is made. The incision must not be placed as low as is usually directed in textbooks. The prostatic and membranous sections of the male urethra correspond to the entire urethra of the female, having the same embryological origin. The duct hugs the under part of the pubic arch. It is as inexpedient to make a low incision for exposure of the membranous urethra in a man, as it would be to cut into the perineum to locate the urethra in a woman. If the incision is made high and parallel to the pubic arch no retractor at the apex of the incision is necessary.

The areolar tissue is next incised laterally and the prostate located by the fingers placed on either side. Once this is accomplished the central tendon is exposed by two fingers acting as lateral tractors. The tendon is carefully cut until the recto-urethralis muscle can be brought into view and so severed. A Proust retractor then replaces the fingers and the fascia is dissected off the prostate until the membranous urethra can be seen, together with the apex and lobes of the prostate.

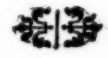
At this stage the operator must orient himself very carefully before proceeding further. With ordinary care the rectum should suffer no injury. Should it be accidentally opened, however, the fact that there is no vesical drainage through the perineum, greatly diminishes the importance of the mishap.

Once the prostate is exposed and the tractor felt in the urethra, an inverted-v incision is made deep into the tissues of the gland. The blade of the scalpel should open the prostatic urethra and expose the tractor. The flap is then pulled down. It contains the prostatic capsule with compressed prostatic tissue, the floor of the prostatic urethra, and the opening of the ejaculatory ducts. Extreme care should be exercised in handling both flap and urethra.

The procedure just described is usually referred to as a prostatectomy, but this is, of course, not strictly accurate. No attempt is made to remove any normal prostatic tissue. By blunt dissection the adenomatous masses around the prostatic urethra are exposed and removed, with the use of a Vacher clamp. We know of no substitute for this valuable forceps. When the neoplastic masses are all cleared away the flap is replaced and sutured in position. The central tendon is then repaired, a small gauze drain placed in one fossa, and a tube, ¼ in. in diameter, with several eyes, placed in the other. The tube is sutured to the skin. The bladder and the perineal wound are irrigated with the metaphen solution and the skin wound

closed with clips. Upon removal of the urethral tractor the operation is completed.

After-care: Pyridium is administered to the patient. The bladder and perineal wound are irrigated regularly, at first hourly, then at gradually extended intervals. There should be no suppuration in either wound, and consequently epididymitis does not develop, rendering preliminary vasotomy superfluous. The gauze drain is removed after twenty-four hours, the perineal tube after a week. The wound is then irrigated by means of a little tube attached to a Luer syringe. As a rule little or no urine drains by the perineum and the wounds heal in a couple of weeks. The patient may get up on the first or second day after operation and on the third begin taking two tub baths a day. These are very invigorating, and keep the perineal and scrotal regions clean. As soon as the perineal wound heals, the cystotomy tube is removed, so that the patient gets around comfortably. All wounds should be healed and the patient urinating naturally within a month from the time of operation.



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* Continued from p. 8.

EXPOSURE OF THE BLADDER AS A STEP PRELIMINARY TO CYSTOSTOMY, PROSTATECTOMY AND LITHOTOMY*

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WILLIAMS,[1] in 1916, described a two-stage cystostomy and strongly advocated its use in the poor risk prostatic and the average patient requiring lithotomy for vesical calculus. The aim of his technique was to prevent gross infection of the suprapubic wound with its attendant dangers and discomforts. Briefly, his method was to expose the bladder in the usual manner, place stay sutures in the bladder wall, pack the wound open with gauze and enter the bladder some four to seven days later. After this interval an aseptic inflamamtory reaction had matted together the component layers of the abdominal wall, sealed off the paravesical tissues and converted the wound into a cleanly granulating trough. The net result was an effective barrier against a dissecting infection. With this operative sequence, prostatectomy became a three-stage affair.

The basic principle here is one utilized fairly frequently in general surgery. Resection of the larynx and excision of an esophageal diverticulum in two steps to lessen the likelihood of a mediastinitis, for example, have the same rationale. The application of this principle to surgery of the bladder and prostate I had never seen suggested prior to Williams' article.

In 1927 I[2] reported to the Urological Section of the Southern Medical Association my happy experience with the method in some 35 or 40 cases during the preceding ten years and stated, in conclusion, that it had secured a very decided alleviation of wound morbidity both in prostatectomies and lithotomies. Keyes[3] gave quite enthusiastic support to the procedure, which he termed prevesical section, in a paper read before the American Urological Association in 1929. While his use of the method had been limited to prostatectomies and lithotomies, he suggested application of the technique to resection and to total cystectomy by an original wider denudation of the bladder. I do not know of any other literature on the subject.

The present paper is based upon a group of 97 additional cases in which the exposure technique has been employed since my first report. The urological diagnoses for the series are shown in Table 1. The

TABLE 1

DIAGNOSES

Hypertrophy prostate	69
Cancer prostate	15
Hypertrophy prostate and calculus	6
Hypertrophy and cancer prostate	3
Paralysis bladder	1
Cancer bladder	1
Calculus bladder	1
Hypertrophy prostate, diverticulum and calculus	1
	97

average age of the patients was sixty-seven years. Two were under fifty, 22 between fifty and sixty, 38 between sixty-one and seventy, and 35 were seventy-one and over. The pus content of the urine was four plus in over 50 per cent of the group. Table II lists the operations performed. The first stage of each operation was, of course, the bladder exposure.

In reviewing our records from 1917 to 1927, I found that 15 or 20 per cent of our one-stage prostatectomies, lithotomies and cystostomies had shown infection to the

[1] Williams, H. The technic of suprapubic cystostomy in badly infected cases. *Ann. Surg.*, 63: 686, 1916.

[2] Neff, J. H. Exposure of the bladder prior to cystostomy or suprapubic prostatectomy. *South. M. J.*, 21: 707, 1928.

[3] Keyes, E. L. Pelvic cellulitis following suprapubic cystostomy and its prevention by prevesical section. *J. Urol.*, 23: 119, 1930.

* Read by invitation before the New York Branch of the American Urological Association, December 4, 1930.

extent of some fascial sloughing. The frequency of infection had naturally been higher for the prostatectomies and lithotomies than for the cystostomies. In order

Table II

OPERATIONS

Prostatectomy, three-stage	43
Prostatectomy, two-stage	24
Cystostomy, two-stage, final	26
Cystostomy, two-stage, pre-prostatectomy	43
Lithotomy, two-stage, pre-prostatectomy	6
Lithotomy, two-stage, final	1
Excision cancer bladder, radium, two-stage	1
Diverticulectomy and prostatectomy, two-stage	1
	145

to minimize infection, such preventive tricks as having the drainage tube emerge high and the inclusion of the bladder wall in the sutures closing the lower angle of the wound had been adopted in practically all cases; for many, additional sutures had anchored the bladder to the rectus muscles at several points. While in no instance was there a pelvic cellulitis, if one means by this suppuration anterior and lateral to the bladder deep behind the pubis, an occasional patient had developed a very serious infection of the wound characterized by brawny induration, ulceration and dusky discoloration of the skin margins, continued sloughing of fascia, these prolonging convalescence materially and imposing a burden that the patient could ill afford to carry. The fact that the patient had been rated as a good risk or had a relatively clean urine, had proved no guarantee against such an occurrence.

The same favorable contrast has been afforded in operations immediately following the preliminary exposure for the present series as had been observed for the former one. Without exception there has been no brawny induration about the wound, no discoloration of the skin, no sloughing of fascia, and a notable absence of pain and tenderness. I do not wish to give the impression that these wounds have healed by first intention. This has been true for only 7 of the 97 cases. But the infection has usually remained superficial and at the worst, with one exception, has confined itself to the granulating gutter. In a single instance, two suppurating tracts have led into the subcutaneous fat for about an inch, obviously following the path of sutures placed at the second operation. In fact, such infection as has occurred has centered about the secondarily placed sutures.

The rapidity with which the fistula closes is possibly some measure of wound health, so to speak, after prostatectomy. For my previous paper, a comparison of two unselected series of 25 prostatectomies handled essentially alike save for the employment or non-employment of preliminary exposure, i.e., one-stage prostatectomies against prostatectomies preceded only by exposure, revealed the average time for closure of the fistula had been decidedly lower in the exposure group. In the two-stage prostatectomies of the present series, the fistula has been solid in three weeks or less for 52 per cent, in four weeks or less for 87 per cent.

The kindly healing after lithotomy is well typified by the result for the stone case of the series which put the method to the severest test. This patient, a prostatic, had seventeen large stones and a foully purulent urine. At no time did this wound have more reaction about it than one frequently gets about a hernia incision. His maximum postoperative temperature was 101°F.

My technique for the exposure has undergone certain changes with increasing experience. The well filled bladder is approached under local anesthesia. The peritoneum and fat are dissected away from the bladder with a knife. The amount of bladder wall exposed naturally varies according to the operation that is to follow. Three guy sutures of fine silk are placed in the bladder wall, one just below the peritoneal reflection and one to each side of the midline at a lower level. Formerly the wound was then packed open with gauze. Now, before putting in the gauze pack, I place temporary double sutures of silkworm gut or heavy silk through muscle and fascia, one or more

of them including a bite of the bladder wall. Superimposed sutures go through fascia and subcutaneous tissue. These are left

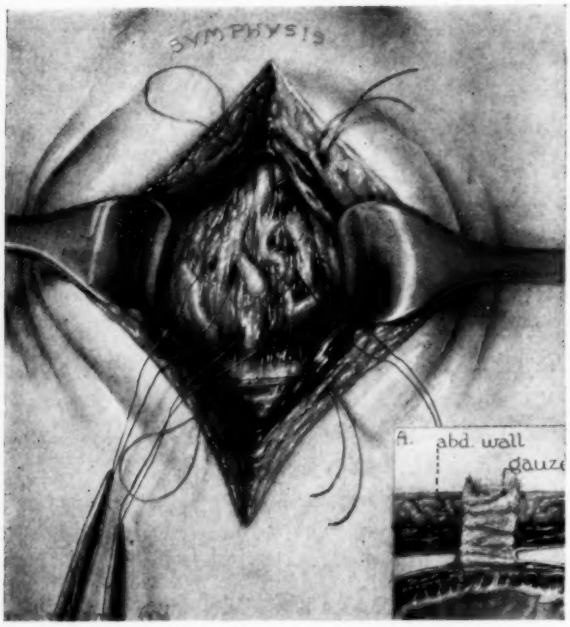

Fig. 1. Customary positions of guy sutures and two of the temporary loop sutures. Superimposed loop sutures through fascia and subcutaneous tissue and untied permanent skin sutures have been omitted to avoid a confusion of suture ends. Insert A shows cross section of wound containing gauze pack.

untied. The loop ends will be used some four or five days later to pull through the permanent sutures. This refinement secures the same aseptic reaction about each suture tract as occurs in the main wound gutter. In the absence of this preparation, any sutures inserted at the second operation must of necessity break through the barrier that has been developed. Such breach has proved a real disadvantage as recited before. Permanent silk sutures are placed in the skin but left untied. The gauze pack is then placed, particular care being taken to hold the peritoneal apron well away from the bladder wall. The three guy sutures are tied over the pack and the wound strapped with adhesive.

Figure 1 illustrates the procedure. For the sake of clarity, I have had shown only two of the temporary loop sutures and have had omitted entirely the permanent sutures in the skin.

There is very little reaction after the exposure and rarely any need to interrupt the patient's routine save that bed confinement is required. In Figure 2 (A) the

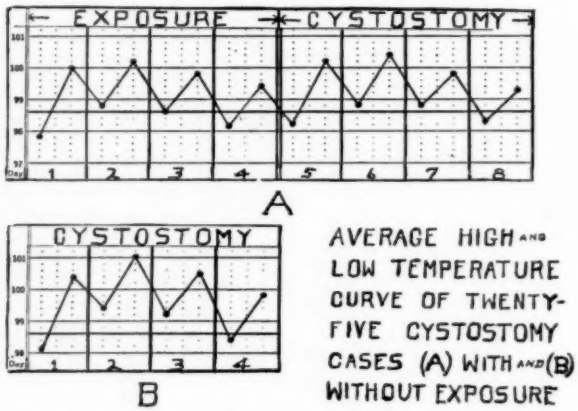

Fig. 2. Note in A that reaction after cystostomy is practically identical with that after preceding exposure. The one-stage cystostomies, B, show maximum temperature .6°F. higher than the two-stage.

average high and low temperatures of 25 patients during the four days of exposure and during the first four days of the immediately subsequent cystostomy are shown. In so far as the temperature curve tells the story, one is struck by the little difference in the reaction following the exposure and the cystostomy. The same figure (B) also records the four-day high and low temperature curve in 25 patients for whom a one-stage cystostomy was done. The maximum temperature was 0.6°F. higher for the latter.

I was really surprised to find such little difference, but, of course, there is less chance for infection in a one-stage cystostomy than in a prostatectomy or lithotomy. It was not feasible to make a similar comparison between one and two-stage prostatectomies because temperature elevation may be caused by so many other factors than wound infection. In the two series the only selection has been to use no cases running an elevated temperature at the time of operation and to exclude those with complications which might be responsible for some febrile reaction.

The exposure period has usually been four days but has varied from three to ten. Upon removal of the gauze pack the wound presents as a granulating

trough. The protective inflammatory reaction is quite thin (Figs. 3 and 4). The tissues are friable and have lost some of their normal elasticity. Tissue handling must, therefore, be gentle to obtain the full benefit of the exposure. The guy sutures exactly locate the point for opening the bladder. At the completion of the second operation, whatever it may be, the temporary loop sutures previously mentioned are utilized to pull the permanent sutures into position, and the skin sutures already in place are tied. Closure is rather loose and additional support is secured by adhesive strapping.

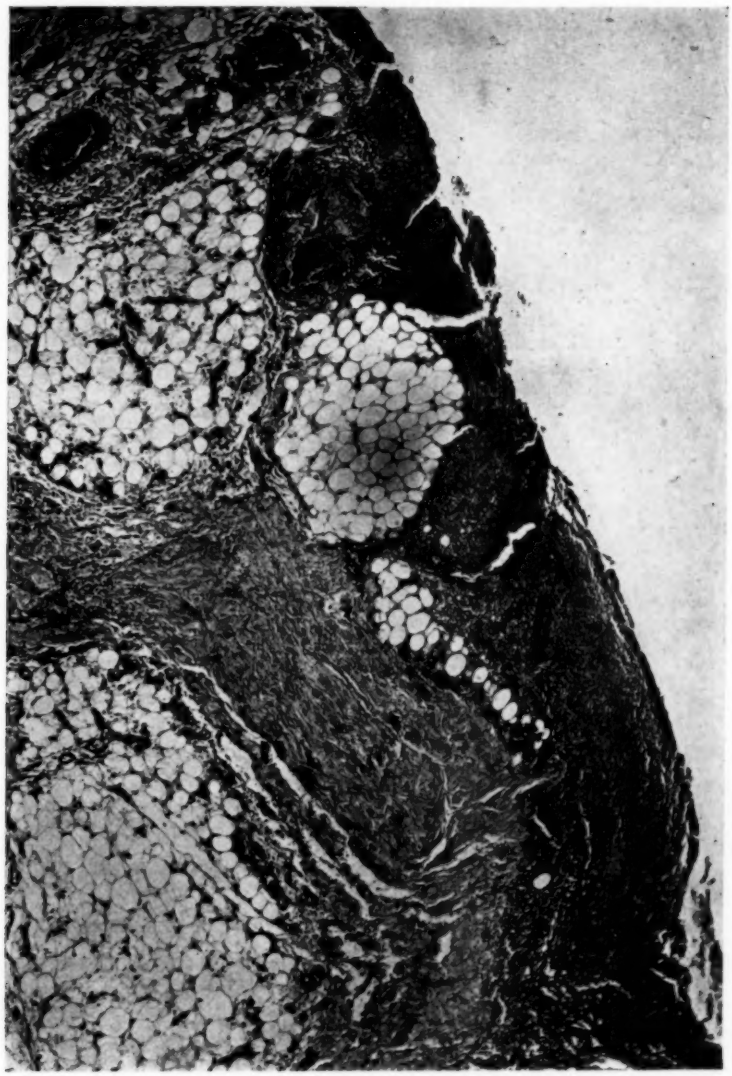

Fig. 3. Section through wall of four-day exposure wound at level of subcutaneous fat. From right to left it shows the serofibrinous exudate, leucocytic infiltration and early fibroblastic reaction.

Williams proposed the preliminary exposure primarily for the poor risk or badly infected prostatic and for the stone cases with marked infection. I have come to use the method in my good risk prostatics as well. The sequence here is drainage preparation by an indwelling catheter, exposure and then prostatectomy. With us, this is the two-stage prostatectomy and has entirely replaced the one-stage operation. It has been employed in about one-third of the prostatectomies (Table II). Whenever a preliminary cystostomy is desirable, the three-stage operation is done. These patients too have their early drainage by means of an indwelling catheter. The exposure technique has

further been utilized prior to the intravesical removal of a large papillary carcinoma of the bladder and the intravesical excision of a large diverticulum coming off from the bladder base. Entirely satisfactory access was had to both conditions. Visualization of a prostatectomy would be, in comparison, a quite simple procedure.

Fig. 4. Reaction from same wound as Fig. 3 but at level of rectus muscle.

Certain objections have been raised to the use of the preliminary exposure. One is that additional confinement is imposed upon the patient. This is more apparent than real for, in my hands at least, the loss at the outset is more than compensated for by the gain of a materially shorter postoperative convalescence. The procedure does add another operation and so consumes more of the operating-room time of the surgeon. This objection has no weight if the procedure rebounds to the benefit of the patient. It has also been suggested that postoperative hernia may be more frequent after the exposure technique. I do not know whether this is true or not. For some years we have obtained a 70 per cent reply to our routine follow-up questionnaires but have found the answers concerning the status of wounds so unreliable that we now disregard them unless there has been the opportunity for personal inspection. I do know that 2 patients in the series of 97 have postoperative herniae, 1 after a three-stage and 1 after a two-stage prostatectomy. A

final objection is that the procedure is unnecessary since any serious infection can be prevented by simpler means. Where true, this cannot be answered. I can only say that, in my work, no other method of avoiding infection has given the same uniformity of good results.

CONCLUSIONS

1. Exposure of the bladder preliminary to cystostomy and other operations has invariably prevented any serious infection of or about the suprapubic wound.

2. The method has prime value in the poor risk and heavily infected prostatic, the prostatic with a fat abdominal wall, and all stone cases requiring lithotomy.

3. Open operations on the prostate and bladder can be readily done with the exposure technique and with the same relative gain in wound healing that is observed for simpler operations.

4. Temporary looped sutures can advantageously be placed at the time of the exposure for the purpose of later guiding permanent sutures into position. The same protective reaction is thereby gained for suture tracts as for the main wound.

DISCUSSION

Dr. Edward L. Keyes: Let me ask three questions: First, as to the length of the abdominal incision, and whether Dr. Neff closes the rectus at all. Then, whether he does a bilateral vasotomy at the time of the first operation. Finally, I should like his views on catheter infection.

In infected stone cases preliminary exposure as outlined by Dr. Neff will aid in keeping the wound clean, and obviate the very high mortality from infection which one finds following suprapubic removal of phosphatic calculi from gravely infected bladders. But I am endeavoring to get away from prevesical section as a preliminary to prostatectomy. One can open a bladder and keep the suprapubic tissue just as clean with a tube in the bladder as though one had only opened the prevesical space. The essence of this operation is, of course, to be sure that no urine gets into the prevesical space at the time of operation.

During the time that I was doing prevesical section preliminary to prostatectomy, I endeavored to make it a two-stage operation, i.e., to expose the bladder in one operation and to remove the prostate a few days later at a second one. For various reasons, however, about one-third of my cases were operated upon three times; i.e., bladder exposure, cystotomy, prostatectomy. The same thing seems to hold for Dr. Neff's series. A careful study of my cases convinced me that the intermediate cystotomy was called for as a rule by prostatitis arising from catheter infection. Indeed, I found that the great advantage derived by me from prevesical section was a clearer understanding of the infectious processes in and about the prostate and in and about the prevesical space that occur during the preparation for suprapubic prostatectomy.

Inasmuch as the prevesical space can be kept clean even though the bladder is opened, I have discarded prevesical section as a preliminary to prostatectomy. I have also discarded the catheter as a therapeutic agent excepting for emergency use, and am now subjecting my prostatics to the following:

1. Cystostomy and bilateral vasotomy on admission.

2. Prostatectomy after an appropriate interval.

3. Decompression which can perfectly well be carried on through the suprapubic tube.

Dr. Abraham Ravich: I have had an experience similar to that mentioned by Dr. Keyes. In fact, over a year ago when Dr. Keyes first became enthusiastic about this three-stage operation, I tried it also, and since then have had about 12 such cases. In spite of bilateral vasectomy performed at the time of the prevesical section, I still continued having infections which I found extending from the vesical neck up as far as the kidneys. These infections I believe are often produced by the catheter lying in the vesical neck. The average hospital stay in these cases was prolonged to about forty-five to fifty days. Since rushing up the first stage recommended by Dr. Keyes and doing a suprapubic cystostomy and bilateral vasectomy without catheterization soon after the patient entered the hospital, I find the results are much better. Infection has been diminished and the hospital stay has been decreased to about twenty to twenty-five days. The patient starts voiding in from three to ten days, and clean wounds are the rule. I believe the three-stage operation may be of value in only the occasional case.

I am in full accord with Dr. Keyes' method as opposed to the three-stage operation as a routine measure.

Dr. Julius J. Valentine: I think there is no question but that Dr. Neff's method of exposure of the bladder is indicated in many cases. I believe, however, that cystotomy by means of air distention of the bladder is much simpler. In discussing the subject, Dr. Keyes did not mention how bladder wounds may be kept clean. Perhaps he had in mind air distention, which technique he demonstrated several years ago on the service at Bellevue Hospital.

Distend the bladder with air (I use the old fashioned rubber bag with bulb for cautery outfit), select the highest point possible on the vault, incise through the muscular coats carefully until the mucosa, a bluish gray bleb, bulges into the wound. Grasp this bulging mucosa with Allis clamps, detach the air distending apparatus, press the bladder gently downward to allow the air and bladder fluid to escape through the indwelling catheter, make traction upward on the mucosa and incise it. If this procedure has been followed, no fluid will soil the wound.

I have followed this technique for over five years and have seen no infections of the wound even in cases of vesical calculus. In my experience, this technique insures at least 90 per cent primary union.

Dr. Daniel A. Sinclair: I was much interested in Dr. Neff's paper, and I have read Dr. Keyes' article on the same subject, but I have seen no necessity for a three-stage operation for prostatectomy or removal of calculi. I do not know why, but within the last twelve years or more I have had no severe infections of the suprapubic wound, such as one saw many years ago. We used to have much sloughing of green, gangrenous tissue. I do not know that the operation I do today is different, but I do not get the infections one occasionally saw some years ago.

Dr. Neff reported a case with 17 calculi in the bladder, citing it as a probable instance where, if the three-stage prostatectomy had not been performed, there might have been severe infection. In March, 1928, I had a similar case from which I removed about 65 large stones, each at least 1 cm. in diameter. I had to dig them out, as they formed a veritable wall cemented together with blood clots. Subsequently I removed the prostate gland, without an unusual degree of infection ensuing. I therefore believe that though in some extraordinary cases of infection Dr. Neff's method might be tried, it should not be recommended as a routine procedure.

Dr. John H. Neff, (*closing*): Relative to the length of the exposure incision which I make, this is determined by the operation that is to follow, being shortest for a permanent cystostomy. The average length is about 7 cm. There is no closure by suture of any part of the wound. The stay sutures in the bladder wall are of fine silk, placed with a curved intestinal needle, and do not penetrate the bladder.

I should estimate that 90 per cent or 95 per cent of our prostatics bear the indwelling catheter satisfactorily. Recently we have been ligating the vasa after the method of Colston and Alyea at the time the catheter is originally passed. Occasionally because of spasm, bleeding, infection or poor drainage, the permanent catheter has to be supplanted by a suprapubic tube. While we employ the three-stage operation rather frequently, it has rarely been made necessary by damage attributable to the presence of the catheter. By reading and conversation I have gained the impression that there is a very definite mortality attached to the routine use of an immediate cystotomy in prostatic obstruction. For the toxic prostatic, the placing of an indwelling catheter has always seemed to me the simplest and safest means of securing the necessary drainage.

I did not discuss mortality in the body of my paper because the study was solely one of wound healing. In this series the mortality was about 8 per cent. This is approximately twice our average mortality for suprapubic prostatectomy over a number of years.

I fear I may have given the impression that infection is rampant with us. I hope the incidence is no higher than in the average clinic. I am convinced that the most perfect technique in a cystostomy is no certain guarantee against a later dissecting infection. One may go into a foul bladder for stones in one stage and have the wound heal per primam. But in 25 consecutive cases of this type, a certain number are surely going to develop some nasty wounds. My experience leads me to believe that none will do so with the exposure technique, though there will be a smaller percentage healing by first intention.

INJURIES OF THE HEAD*

PAUL D. ABRAMSON, M.D.

SHREVEPORT, LA.

HEAD injuries constitute an ever-increasing number of traumatic cases seen, in all probability the result of the mechanical age in which we live. On all sides we are surrounded with evidence of man's conquest of the inanimate and of his victory over the elements, all of which, their advantages notwithstanding, result in more frequent and in more serious accidents; and, of these, head traumata are foremost in importance, not only because of the frequently prolonged period required in the immediate treatment of these cases, but equally as much because of the after-effects of such injuries which frequently are more disabling and cause more economic loss than the original injury. As in many other fields of medical endeavor, there is no conformity as to diagnosis (classification) or to treatment, resulting in a somewhat confusing state of affairs, but there are certain general facts which if recognized and used as a basis of treatment will perhaps serve to place the subject of head injuries into a semiorderly category.

In the first place, there is one distinction to be made, viz., that in treating cases of head injury we are never primarily concerned with skull fracture *per se*, but with damage to the enclosed brain and its coverings; bony damage interests us only so much as it affects the enclosed contents. It is true that extensive fractures of the skull almost invariably damage the underlying structures, but this is not the infallible rule; and conversely, "negative" *x*-rays have all too often caused a false sense of security, with an underestimation of the seriousness of the intracranial pathology, and a resulting laxity and inadequacy of treatment, not infrequently resulting in sequelae which may permanently cripple the individual so afflicted.

When a head injury case is first seen, as in all cases of trauma, the first and paramount thing is to recognize shock if present, and treat it promptly. The symptoms are too well known to bear repetition here, but it must be remembered that the falling blood pressure and rising pulse rate of primary shock are closely mimicked by the symptoms of medullary edema, with the exception of the rising temperature in severe medullary damage as contrasted with the subnormal temperature of shock. Until shock is combated, nothing can be done, assuming an attitude of "masterful inactivity" even in the face of family discontent; for we can rest well assured that if the patient fails to react from this state any measures which we may have undertaken would but hasten the end.

There is a peculiar thing about the treatment of shock in head trauma: most of the usual methods for combating it under ordinary circumstances are frequently contraindicated. Thus, in shock the lowered head is of great value, while in head trauma the elevated head is desirable. As a result, unless an alarming degree of shock be present, the flat position is to be used. Again, whereas fluids are useful in the treatment of this condition, too much fluid is harmful in intracranial damage; so again, unless an unusual degree of shock be existent, it is perhaps best not to force fluids. Morphine is the drug *par excellence* in the treatment of shock, but Carl Rand lists at least three contraindications to its routine use in this type of case, viz., (1) in a case of head injury, especially of severe grade, the increased intracranial pressure usually causes embarrassment and depression of respiration and pulse; morphine accentuates this depressing action and it often fails to quiet; (2) mor-

* Read in part before North Louisiana Sanitarium Staff, November, 1930.

phine contracts the pupils and thus masks the development of localizing signs; and (3) it tends to mask the symptoms of

Fig. 1. F. G., aged three years, admitted to Charity Hospital October 15, 1930. Despite quite definite fracture, the patient presented absolutely no clinical evidence of intracranial pathology. Such an occurrence is more frequently seen in children than in adults.

oncoming stupor due to cerebral edema or hemorrhage. As a result, the treatment of shock in head injuries largely resolves itself into absolute quiet in bed in the flat position, external heat and the use of luminal, chloral or some similar sedative.

After the patient has reacted from any shock that may have been present, a more careful survey must be made with a view of determining the degree of intracranial damage present. Emphasis is again placed on the fact that it is this intracranial damage that is the paramount issue and not the bony damage itself. True it is that the degree of skull injury is a fair index of the amount of intracranial pathology to expect, though there is by no means an absolute correlation; especially in children is it true that notwithstanding severe bony damage there may be relatively little brain damage (see Fig. 1). The site of scalp laceration or contusion frequently indicates the site of severest brain injury, but the possibility of the contrecoup mechanism must be borne in mind both as regards intracranial damage and skull fracture; the entire brain is frequently damaged, or in the words of Frazier:

> One should see in the severely contused and lacerated brain a diffuse lesion, areas of extravasations, minute petechial hemorrhages far distant from the site of impact, in hemispheres, pons or medulla, minute or gross lesions. Superimposed on these there is a rapidly spreading edema from cortex to brain stem . . . thus one should visualize the tissues of the damaged brain.

The usual classification of brain damage is one based on an admixture of disturbed physiology and disturbed anatomy. Most grade the cerebral damage into (1) concussion, (2) contusion and (3) laceration, there being only a difference of degree between them and no sharp dividing line; with each there is a variable degree of cerebral edema. In concussion, and there is no unanimity of opinion that such a condition really exists, the prime clinical feature is a temporary period of unconsciousness, the severity of the injury presumably interrupting the physiological integrity of the brain cells. It is unaccompanied by actual brain damage, and hence a bloodless spinal fluid is obtained. Laceration and contusion, on the other hand, cause actual brain damage and can occur entirely independently of any actual fracture, in such cases resulting from the jolting of the brain inside its bony encapsulation.

These three grades of cerebral damage are, in themselves, primarily of little importance excepting as they result in severe edema or intracranial hemorrhage which in turn produces that all-important result of head injuries: increased intracranial pressure. It is this increased pressure which results in (4) medullary compression and (5) medullary edema; and it is this disturbance of the medulla wherein are located the so-called "vital centers" that is responsible for the extreme seriousness of head injuries.

Thus we see that intracranial damage may be classified under 5 groupings: (1) cerebral concussion, (2) cerebral contusion,

(3) cerebral laceration (4) medullary compression and (5) medullary edema. Let it be understood, however, that clinically cases cannot be neatly pigeon-holed into any one classification but frequently present a composite picture of 2 or more grades of intracranial pathology.

Fractures of the skull permit of a simpler classification and must be considered because of their relationship to cerebral damage. According to location they are either (1) basal or (2) vault fractures; and in turn, the fractures of the vault may be subdivided, depending upon the number and position of the fragments, into (a) fissured, (b) comminuted (c) diastatic (separated fragments), (d) depressed or (e) perforated. Obviously, the depressed type of fracture is more likely to severely damage the brain. As Reed points out, for practical purposes, fracture of the skull may be dismissed unless it falls into one of 3 types: (1) depressed fracture of the vault, (2) a compound fracture under a scalp wound and (3) fracture of the base when the fracture line extends through the external auditory meatus or through one of the accessory bony sinuses. The possibility of a contrecoup fracture must not be overlooked.

When a patient who has sustained a head injury is first seen, whether he has reacted from his shock or not, there is no reason at all for madly rushing him to the *x*-ray room to see if he has a "fractured skull or not." Such information is of little real value, is often misleading and frequently the handling of the patient necessitated by taking the picture is harmful; and as has been previously observed, "negative" *x*-ray findings often give an unwarranted optimism and may result in laxity of treatment. All the information required, certainly all that is necessary at the initiation of treatment can be determined by clinical examination. *X*-rays should be taken, of course, as much for a matter of record as anything else, but this should not be allowed to supersede everything else that is done for the patient. That is, the patient's treatment must not depend upon the presence or absence of a demonstrable fracture, but upon his clinical condition.

Fig. 2. E. B. R., aged twenty-two years, admitted to North Louisiana Sanitarium November 15, 1930. Although other views of the skull showed no more evidence of fracture than the lateral, this patient was unconscious for five days and showed signs and symptoms of marked intracranial pathology for over a month before returning to normalcy under medical (conservative) therapeusis. Although it is true that it is often difficult to satisfactorily demonstrate basal fractures with the *x*-ray, this patient had no clinical evidence of basal fracture, the brain injury apparently being in the left frontal lobe. As this case well illustrates, severe intracranial damage frequently occurs without any actual skull fracture.

Clinical evidence of fracture is always to be looked for first, with the object uppermost of correlating it with possible intracranial pathology. If a laceration of the scalp is present, it is a simple matter to daub the wound and surrounding area with a little iodine and insert the gloved finger into the wound, endeavoring to feel any bony defect or other evidence of fracture. Such an examination is by no means conclusive, but certainly helpful. On digital examination, evidence of depression must be carefully sought for, and it is in a case of probable depression that *x*-rays are of great value. Serious fractures of the vault can usually be palpated; serious fractures of the base usually, though not invariably, evidence themselves by periorbital or perimastoid bleeding, conjunctival hemorrhage or es-

caping blood or spinal fluid from the nose, mouth or ears. Naturally, severe cranial damage usually indicates severe intracranial damage but this is not invariable, and it is to be remembered that severe brain damage can occur with an intact skull (see Fig. 2).

As Frazier has aptly said, cerebral trauma is as much a neurosurgical problem as cerebral tumor. Advantage must be taken of localizing signs as evidence of cranial or intracranial pathology. The eyes are most frequently observed for evidence of severe pathology. Blakeslee, in a series of 610 cases at the Harlem Hospital, found that 78 per cent of cases of *fracture* showed eye signs: 79 per cent of these signs were some kind of pupillary alteration. Immediately after the injury the pupils are more or less dilated and sluggish in reaction; as the stage of shock passes off the pupil returns to normalcy unless there is a marked increase of intracranial tension when dilatation and sluggishness may remain. Pinpoint pupils are seen in the early stages of supra-cortical hemorrhage; a dilated and fixed pupil is usually seen on the side of the lesion and like nystagmus, is an unfavorable sign. Fundal changes are of little value early as an index of intracranial pressure, though some dilatation and engorgement of the retinal veins are seen early in cases of increased tension. According to Armour, about 12 per cent of cases show some cranial nerve involvement; in order of frequency the nerves involved are the seventh, sixth, eighth, third and second. Greenleaf has claimed that unilateral elevation of the temperature in the axilla occurs on the side opposite the lesion.

Concussion, the mildest form of intracranial pathology, is evidenced by a primary brief period of unconsciousness, mental confusion or disorientation, lack of localizing cortical signs and bloodless spinal fluid. However, Mestrezat, Bouttier and Lorge have, according to Armour, described a spinal fluid "concussion formula" which is detectable in 80 per cent of the cases of concussion without head wounds: the spinal fluid findings consisting of increased tension, increased albumin, normal chlorides, slightly increased sugar, absent fibrin and normal permeability. If the treatment of this condition is not discontinued too early, it usually leaves the patient unscathed.

Cerebral contusion and laceration are severer grades of the same process. Whether due to a concomitant cerebral edema or to concussion, such injuries are frequently associated with varying degrees of mental alteration varying from simple transient disorientation to wild mania or deep coma. If a spinal tap be done, almost invariably a bloody spinal fluid under increased tension is found. It is this increased intracranial pressure that so frequently accompanies the severer degrees of cerebral damage that is responsible, through pressure on the medulla, for the production of some of the classical signs of head injuries. In increasing medullary compression there is seen the compensatory slowing of the pulse (which in reality is the most reliable clinical sign of increasing intracranial pressure). Vomiting is entirely undependable as an index of increasing pressure: it is much more often due to nervousness or excitement than to any increased intracranial pressure and is rarely projectile. Likewise, blood pressure readings are entirely worthless as a reliable index of increasing intracranial tension; occasionally a compensatory rise of blood pressure is seen accompanying increased pressure, but this factor is so variable that reliance upon it will be frequently misleading. As medullary compression passes into medullary edema the patient lapses into extremis: falling blood pressure, rapidly increasing intracranial pressure, rising pulse rate and hyperpyrexia are all ominous signs of impending disaster.

Aside from certain definite surgical indications, the thing of most importance is, after all, the amount of intracranial pressure.* So much so that Rodman and Neu-

* Those who practice extreme conservatism argue that actual brain damage, and not increased intra-

bauer have discarded the usual methods of classification and grouped all cases of head injuries into 3 types, depending upon the degree of intracranial tension. Increasing intracranial pressure is usually evidenced by deepening coma (the pressure causes an acute anemia of the brain cells and loss of function), slowing pulse, slow deep breathing and increasing spinal manometric readings. If compensation breaks, the picture of medulle arydema replaces that of medullary compression.

The surgical indications in head injuries are definite and relatively few; aside from the repair of scalp wounds there are just 3 indications for surgery (Reed):

(1) To prevent infection, as after a compound fracture involving the scalp or accessory sinuses.

(2) To reduce cerebral compression, or

(3) To elevate depressed fractures of the vault.

That is, if there is no depressed fracture of the vault, if there is not an alarming degree of cerebral compression present, and if there is no danger of infection from a compound fracture, conservative (medical) therapeusis is ndicated in handling the particular case of head injury in question.

Treatment of head injuries varies greatly; in the words of Dandy, "The treatment . . . so largely in vogue at present, when taken compositely, is a curious admixture of tradition, scientific facts and of fallacies which pass under the cloak of science." Measures recommended vary from one extreme to the other. No less an authority than Dandy states that 70 per cent of head injury cases will recover if left absolutely alone, 20 per cent will die regardless of what is done, and a scant 10 per cent are benefitted by judicious treatment, and concludes that these patients should be left absolutely alone until it is evident that nature is unable to cope with the situation.

Most, however, do not adopt such a "radical conservatism"; there are certain, though few, things that are frequently used. In those cases in which no surgical indication is present, the patient is put to bed in Fowler's position, thus mechanically alleviating the increased intracranial pressure; an ice-bag is usually placed to the head: this is probably one of the "traditions" to which Dandy had reference—in the conscious patient it no doubt serves to keep him still for fear it will topple off, but otherwise its value is extremely doubtful, though almost universally used. Saturated $MgSO_4$ by mouth, if the patient is conscious; by duodenal tube, if the patient is comatose (or by rectum as the English do) as is well known, serves indirectly to reduce intracranial pressure. Intravenous hypertonic solutions of various kinds are of undoubted value; of these, 50 per cent glucose in 50 to 75 c.c. amounts is definitely the best of the lot. Hypertonic saline, which has at times been used, in addition to having no nutritional value has several distinct disadvantages including the toxicity of the Na ion and the fact that the NaCl diffuses into the tissues and there attracts water, thus waterlogging those structures primarily dehydrated. In the use of glucose, it is quite important that urinalyses be done before treatment is instituted and while it is being carried out; diabetics are not immune to head injuries.

The rôle of spinal puncture in relieving increased intracranial pressure is another one of the measures about which there is no agreement, varying from absolute abstinence (Dandy, who believes that spinal puncture but serves to re-traumatize the intracranial structures) to total drainage (Temple Fay). No doubt a middle course is wiser and certainly it is more universely adopted. Probably drainage in the first twelve to twenty-four hours is inadvisable as it only disturbs an already

cranial pressure, is the cause of the clinical symptoms. It certainly is difficult to otherwise explain those cases which are sometimes seen in which there is profound coma, etc., but in which, with no apparent blockage (Queckenstedt) there is normal, or only slightly elevated spinal manometric readings. A review of our records fails to reveal a single instance of the spinal hypotension of Leriche, though it is said to occur in about 3 per cent of head injuries.

too-disturbed patient; it may defeat a compensatory pressure having for its purpose the compression of bleeding vessels. And if, within this short preliminary period, the pressure reaches dangerous levels, the case is probably too far gone to save, regardless.

Probably a safe rule in performing spinal drainage is to draw off sufficient fluid to reduce the pressure one-half of the increase above normal. It is extremely important, in performing spinal taps, that the actual pressure be recorded; absolutely no reliance can be placed upon the number and force of the drops from the needle, because of the great variation in needle bore, the possibility of tissue impinging against the needle, of the needle being slightly bent, etc. All these factors obviate the possibility of accurate spinal pressure estimations by the escaping fluid. If a regular mercury or water spinal manometer is not available, a very passable substitute can be had in the form of the ordinary blood pressure manometer providing that the cuff is detachable: the rubber connection that is found in all sets of antimeningococcic serum for intraspinous use forms an admirable connecting link between the spinal needle and the mercury column. Furthermore, in reducing the pressure, no reliance should be placed on the removal of any certain quantity of fluid; it is the reduction of pressure that is essential and readings should be taken before and after drainage. À propos of intracranial pressure measurements, it is interesting to note that Bailliart has described an instrument called the "ophthalmodynamometer" by which the intracranial pressure can be determined by pressure on the eyeball and simultaneous observations of the central artery of the retina. This method has not found very widespread use.

Sedatives such as luminal are preferable to bromides because of the cumulative effect of the latter. Restriction of fluids to practically nothing at first is of great value; this is all too frequently overlooked in the handling of head injuries. Restriction of fluids, according to Temple Fay, should be continued over a relatively long period of time.

If the increasing intracranial pressure fails to respond to these measures of position, epsom salts, intravenous glucose and spinal drainage, the case falls into one of the indications for surgical intervention: cerebral compression. Cerebral compression may be the result of (1) cerebral edema of severe degree, (2) cerebral laceration and severe subdural hemorrhage or (3) extradural hemorrhage. Characteristically, extradural hemorrhage evidences itself by a primary coma, a period of lucidity and then secondary unconsciousness, and if such a chain of symptoms presents itself, there is immediate need for subtemporal decompression, to control the bleeding as well as to relieve the compression. The bleeding almost invariably is due to a tear in the middle meningeal artery which enters the skull through the foramen spinosum, or to a tear in one of its branches. If, however, no such characteristic symptom-chain is present, it may be impossible to differentiate clinically extradural hemorrhage, subdural hemorrhage or cerebral edema of severe grade. Nevertheless, the indications are clear for a subtemporal decompression, dealing with whichever condition presents itself. However, a preceding spinal tap may serve for a differentiation as a clear fluid mitigates against the diagnosis of subdural hemorrhage, narrowing the probable diagnosis down to extradural hemorrhage or cerebral edema: if there has been, in addition, a period of lucidity and then secondary coma, the diagnosis of extradural hemorrhage will be practically certain. Spinal drainage will never relieve a case of extradural hemorrhage and may be actually harmful (one of the dangers of indiscriminate spinal puncture as a routine procedure); but it may at times obviate the necessity of operation in cases of subdural hemorrhage, unless a severe degree of intracranial pressure be present.

In relieving cerebral compression, regardless of the cause or location of the

cerebral laceration, and regardless of the exact pathology involved, a subtemporal decompression is the procedure *par excellence*. Armour points out the following advantages of this procedure: (1) the squamous portion of the temporal bone is the thinnest part of the vault of the skull and so it is easiest of removal; (2) its removal exposes the middle meningeal artery which is most frequently damaged: (3) the part of the brain exposed is the temperosphenoidal lobe, a silent area of the brain and (4) it allows drainage of the middle fossa in its lowest point. It must be remembered that in relieving intracranial pressure it is essential to open the dura; simply removing a bony plate is useless. Incidentally, Lambert Rogers of Cardiff has recently described a very ingenious "skull plow" which promises to greatly simplify the technique of osteoplastic craniotomy.

The second definite operative indication is to relieve a depressed fracture of the vault. Here the incision is made so that the involved bone is exposed; the depressed bones are elevated and left in place to serve as a graft if the wound is not compounded and there is no danger of infection. Failure to properly elevate depressed fractures may result in persistent headaches, personality changes, Jacksonian epilepsy, localized paralysis, brain cysts, etc.

The third operative indication is for the prevention of infection. The management under this indication depends on whether the fracture is of the vault, into the frontal fossa or into the base. If in the base, and there is bleeding from the ear, the ear should be plugged with sterile cotton soaked in some antiseptic solution and no attempt made to aspirate or "blow out" the ear; in examining the ear to see if the bleeding is really coming from a rent in the ear drum, aseptic precautions should be used.

If the compound fracture is of the vault, the involved area is widely shaved and prepared and all loose fragments of bone are removed, because of the potential infection. The dura is inspected for lacerations and, if present, the underlying brain probed (preferably with an old soft rubber catheter of small size) for penetrating fragments which must be removed. The dura is closed, if necessary with a fascial graft, to prevent infection or hernia (fungus) cerebri. Likewise, the scalp should be closed without drainage. If a large bony defect exists it can be repaired at some future date.

If, however, the fracture extends into the frontal fossa or accessory nasal sinuses, the possibility of infection is greatly enhanced. Meningitis is the chief hazard of such a fracture. If the fracture is of the posterior wall of the frontal sinus an osteocutaneous flap is made, exposing the interior of the front al sinus.Treatment thereafter is carried out as in compound fracture of the vault. If, however, the site of fracture cannot be thus attacked, Teachenor has recommended drainage of the frontal sinus because these patients have an intranasal irritation due to blood, etc., which causes an irresistible desire to sneeze; if the frontal sinus is closed tightly, obviously such sneezing will but serve to force infected material into the brain and meninges, whereas if a drain is in place, the tension will be less and the infectious material will escape through this opening.

Briefly, then, if no one of the 3 surgical indications is present, viz., (1) compound fracture with danger of infection, (2) depressed fracture of vault or (3) marked cerebral compression (hemorrhage or edema) the patient is put to bed with elevated head, ice-bag to head (*sic!*), $MgSO_4$ by mouth or tube, 50 per cent glucose by vein, and after the first twelve to twenty-four hours, unless definitely contraindicated, spinal drainage is instituted. Fluid intake is limited. Even though the patient responds nicely to this therapy it must not be abandoned too soon because it is by such inadequate and curtailed therapy that some of the more serious sequelae such as persistent headache, vertigo, personality changes, etc., result.

All head cases must be considered serious until proved otherwise, and they should, no matter how apparently trivial, be kept in bed at least a week to avoid, if possible, such unfortunate and handicapping sequelae.

Frequently, following the severer grades of head injuries, mental changes persist over a relatively long period of time: these alterations are extremely varied and protean in their manifestations. As a rule, these are rather indiscriminately grouped under the rather ambiguous appellation of "traumatic psychosis." After a varying length of time, weeks or even months later, these mental aberrations disappear, though at times, even in the absence of a fracture, permanent mental changes occur.

The sequelae of head injuries must not be forgotten. One of the most frequent and troublesome of these is persistent headache and vertigo: it is in these cases that Penfield has recommended the spinal insufflation of air, on the theory that these symptoms are the result of thin filamentous adhesions which are broken up by the entrance of the air.

A more serious sequela is that of chronic subdural hematoma (pachymeningitis hemorrhagica interna) which following even trivial trauma may evidence itself in several weeks or months either as a disturbed mentality (and is frequently misdiagnosed "traumatic psychosis") or as a symptom-complex of persistent increased intracranial pressure. The recognition of this condition is important because the spontaneous absorption of the encapsulated clot in the avascular subdural space is rare, while operative removal is followed by a brilliant cure.

An intracranial aerocele or pneumatocele is occasionally seen following communication between sinuses or mastoid and the intracranium. It evidences itself by increased intracranial pressure and sometimes sneezing followed by cerebrospinal rhinorrhea. X-rays readily confirm the diagnosis. The treatment is repair of the dural defect.

Subdural hydroma is sometimes seen and resembles a subdural hematoma except that the accumulated fluid is more serous in character and the encapsulation is usually thinner than that surrounding a hematoma. The symptoms are manifested as a persistent headache and a syndrome of increased intracranial pressure, and may be alleviated by removal of the accumulated fluid.

Persistent involvement of the cranial nerves, particularly the facial, at times gives great concern. There are several other sequelae which are seen rarely, but their rarity does not warrant mention here.

Concerning these results, or after-effects of head injuries, one must not be too hasty in attributing symptoms or signs to a previous trauma about the head. This point is well illustrated by a case recently seen.

J. N., a colored male aged forty years was admitted to the Sanitarium complaining of persistent headaches and some mental disturbances. He dated his symptoms quite definitely to a head injury received some two months previously. There was, of course, the all-important medico-legal aspect of the case. Physical examination revealed little of note except fixed and unequal pupils, which, incidentally, has been claimed by some to occur as the result of head injuries, in certain cases. Spinal fluid examination revealed a 4 plus Wassermann reaction and a paretic curve. Needless to say, the symptoms have markedly improved under anti-luetic treatment.*

SUMMARY AND CONCLUSIONS

1. In treating head injury cases it must be fully realized that it is the intracranial damage with which we are primarily concerned and not the presence or absence of a fracture.

2. There is no need for rushing the patient to the *x*-ray room to demonstrate the presence or absence of a fracture: the

* It must be remembered that some claim that trauma, by producing a *situs minoris resistentiae*, may actually precipitate paresis in a luetic individual. See the recent excellent discussion of this subject by Klauder and Solomon, *J.A.M.A.*, 96: 1–7, 1931.

clinical condition of the patient is the essential thing.

3. Treatment of shock must, of course, preclude all other therapy.

4. There are 3 surgical indications in the treatment of head trauma: (1) to prevent infection, (2) to elevate depressed fractures and (3) to relieve high grades of cerebral compression, whatever the cause.

5. If no surgical indication is present the case is best treated with elevated head, limited fluid intake, $MgSO_4$ by mouth, hypertonic glucose by vein and, after twelve to twenty-four hours, unless definitely contraindicated, spinal drainage.

6. Absence of demonstrable fracture must not permit of laxity or insufficiency of treatment, as it is entirely possible to have severe grades of intracranial damage, even a fatal outcome, with no actual fracture.

7. All head injury cases must be considered serious until proved otherwise; adequate treatment will frequently prevent the development of serious and handicapping sequelae.

8. The possibility of the development of late sequelae must be remembered in all head injury cases, but symptoms must not be attributed to a previous trauma without proper study.

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*Continued from p. 36.

ARGENTAFFINE TUMORS OF THE SMALL BOWEL

WITH REPORT OF TWO WHICH CAUSED INTESTINAL OBSTRUCTION*

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FROM the first report of Merling[1] in 1835, at which time he reported a case of primary carcinoma of the appendix, to 1908, McWilliams[2] was able to collect from the literature 90 cases of primary appendiceal carcinoma. Meyer[3] in 1915 compiled 269 cases, and Jackson[4] adding 54 in 1923 brought the total to 317. In the intervening seven years between this publication and the present, investigators have submitted many papers reporting additional tumors. The collection has become so large that their single occurrence is hardly noteworthy. Many of these studies are entirely adequate in review, and because of this previous literature the appendiceal tumors are not considered here.

Carcinoid or argentaffine tumors occurring elsewhere in the bowel other than the appendix are less common. One can only guess at the number of early tumors of the small bowel which were of carcinoid character because of the relatively recent separation of them from the great group of intestinal cancer, but from previous collections of cases it is evident that they have been rare. For instance Nothnagel[5] in an analysis of the material from the Allegemeines Krankenhaus in Vienna from 1870 to 1893 found 343 intestinal carcinomata from 41,838 autopsies. Of these but 10 were of the jejunum, ileum or appendix, which are the principal sites in which argentaffine tumors have been reported. Similarly Leichtenstern[6] found 780 intestinal carcinomata with only 28 from the ileum, jejunum and appendix. Lubarsch[7] in 1888 could find only 35 cases of tumor of the small intestine reported in the literature. G. Heimann[8] reports of 20,054 cases of cancer in the Hospital of Prussia; 20 were in the small bowel. Stengel,[9] combining the statistics of Madyl, Nothnagel, Zeiman, Muller and Bryant, shows that 13.4 per cent of all carcinomata to occur in the cecum, appendix and small bowel with the cecum producing over 50 per cent of these. Brill[10] concludes that 2 to 3 per cent of all cancers of the gastrointestinal tract occur in the small intestine. In view of these figures and realizing that not over one-half of this total are tumors of the carcinoid type, the rare instance of argentaffine tumors here is impressive.

The probable reasons for the low occurrence of malignancies in the small bowel as Bunting,[11] Waldeyer,[12] Birch-Hirschfeld,[13] and Ransom,[14] have indicated are: (1) the lack of epithelial transition points; (2) the absence of areas of irritation; and (3) the poor nutritive qualities of the bowel wall. The reason for the occurrence of argentaffine tumors occurring here are just as unsatisfactory, and no less than a dozen theories have been advanced in explanation of their development. It is a needless repetition to include them here as Forbus[15] has followed these theoretical developments chronologically from Berger's[16] report in 1882 to Masson's[17] recent and apparently conclusive work. We wish to add to Forbus' list Ehrlich's[18] theory, published in 1914, that the tumors arose from Auerbach's plexus. He believed that they were immature neurocytomata, a theory with which Masson does not agree. In 1928 Semstroth[19] reported a case of a patient dying from other causes showing at autopsy a small, firm, white and apparently homogenous nodule on the top of the head of the pancreas. It appeared much like an islet. There were several nodules in the duodenal wall somewhat smaller than these but of a similar character both in gross appearance and cell morphology.

* Submitted for publication October 3, 1930.

They looked like carcinoids although they showed no reducing granules when stained by Hasegawa's[20] method. In the muscularis of the duodenum were several adenomyomata. All of the tumors were in the first two portions. He concluded that the tumors arose from faulty differentiation of the entoderm, heterotopic in the duodenum, and homotopic in the pancreas, a view that recalls Trappe's[21] theory. The name "hamartoma" (E. Albrecht) was applied to them.

The present theory of Masson's[17] seems, at most, possible. He concludes that the cell of genesis lies at the bottom of the glands of Leiberkühn.[22] They were described by Nicolas Kultschitzky[23] in 1897 and occur in the gastrointestinal tract from the stomach to the rectum. According to Masson, a cell, by budding and emigration, grows into a nerve where it assumes its type. The cells do not normally propagate, but pile up in the nerve because of the obstructions of ganglia. They may occasionally break out however into the adjacent tissue. The neurocrine cells proliferating in this abnormal medium form a nidus which in development assumes the characteristics of argentaffine tumor.

Non-invasion and the non-metastatic characteristic of the carcinoids were the bases of early differentiation of carcinoids from carcinomata. Recent studies have shown them to be not all benign. Ransom[14] in 1890 described a carcinoid of the ileum with metastases in the liver and though many doubted the carcinoid character of this tumor there now seems little question as to the true nature of it in the case of one patient. This patient died from the tumor growth. It is interesting to note that Ransom held the vacuoles in the tumors to be blood vessels rather than degenerating spots which was then the common belief. Masson, after thirty-eight years, proves the vacuoles to be the vascular centers of cellular rosettes.

Walter[24] in 1896 described a carcinoid invading the gut wall and mesentery for a short distance. Stewart and Taylor[25] reported a case of carcinoid tumor of the appendix which showed large pelvic deposits of the same sort of tissue. These

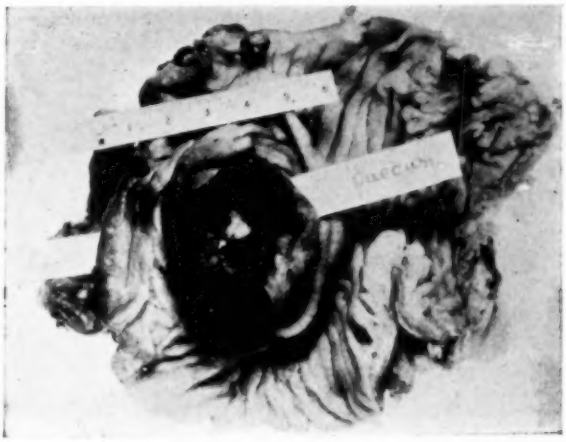

Fig. 1. Tumor on posterior lip of ileocecal valve.

masses were retrouterine and 4 to 5 cm. each in size. The appendiceal tumor was invading the peritoneum. All of the tumor was removed eleven years ago and the patient is living and well. They collected from the literature 17 other cases of carcinoid tumor with evidence of metastasis. Of 8 primary in the appendix and 9 primary in the small intestine, they found that 12 had metastasized to the peritoneum, 6 to the regional lymph glands, 7 to the liver, and 1 to the pleura. It appears from this as well as from our own experience that the extending tendency is much stronger in the tumors of the intestine than in those of the appendix.

Dukes and Lockhart-Mummery[26] report a seventy-six-year old woman who had general indigestion for a year, and in whom a tumor on the posterior lip of the ileocecal valve which constricted the lumen of the ileum and projected into the cecum was found. The lymph glands behind the cecum were very large and infiltrated. The tumor gave the argentaffine reaction of Masson. Ransom,[14] Warren,[27] Brocher,[28] McGannan and McCleary,[29] and Thibadau and Burke,[30] report tumors at or near the ileocecal valve with partial obstruction, intussusception, or prolapse of the ileum and regional extension to the glands or peritoneum.

Two cases are recorded here which presented symptoms of chronic intestinal obstruction due to this rare tumor. One was in the ileum and had invaded the adjacent lymph nodes, and the other arose from the last 2 in. of the ileum, proving of interest because of its unusual situation and structure.

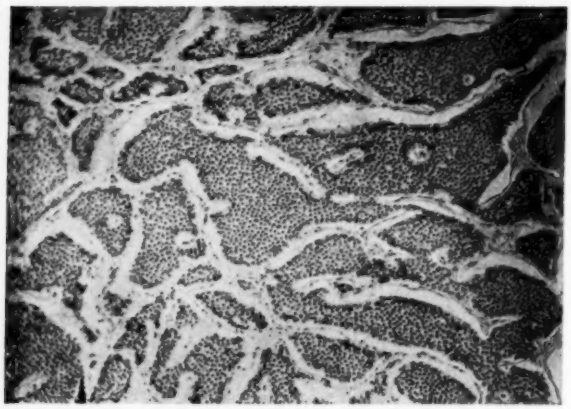

Fig. 2. Typical stroma, cell islands and rosettes.

CASE REPORT

Case 1. Mr. W. P. Male, white, aged sixty-one. Service of Dr. W. I. Terry.

Twenty years before entry this patient had had an appendectomy by an unknown surgeon. Ten years before entry external hemorrhoids had been removed for their local symptoms. The patient had lived otherwise normally except for recurring attacks of headache of migraine type coincident with indigestion and diarrhea. The attacks were at from one to three week intervals and would last two or three days, ending spontaneously. For six months before entry the attacks were intensified, the diarrhea was profuse with small amounts of fresh blood and severe lower abdominal pain before and after stools. There was no loss of strength of weight.

At physical examination the heart and lungs were found to be normal. The abdomen had a well healed, right lower quadrant scar below which was a hard palpable mass 3 cm. in diameter. The cecum was tender and boggy. The liver projected 2 cm. below the costal margin. The abdomen was otherwise negative. Proctoscopy showed a mild injection of the rectal mucosa. The prostate was normal.

An *x*-ray series showed a normal gastrointestinal tract excepting a constant defect in the cecum near the ileocecal valve which was apparently due to a tumor in the cecum. At operation a mass of omental adhesions was found in the region of the old wound. In this plastic mass was a small gauze sponge surrounded by fibrous tissue. Within the cecum was a pedunculated tumor projecting from the posterior lip of the ileocecal valve (Fig. 1). Arising by a root stalk of fibrous tissue 1 cm. long and 1 cm. in diameter, it expanded abruptly into a spherical mass 4 cm. in diameter. The mucosa rose up the stalk to the periphery, and the upper surface was bare. Upon section the fibrous strands radiating from the head of the pedicle were found to support a very yellow, friable, cellular tissue which in areas suggested an adenomatous pattern. There were no extensions or metastases. The tumor (Fig. 2) upon microscopic studies showed a heavy fibrous stroma, lightly infiltrated with lymphocytes and supporting sheets and islands of medium sized cells with pale granular nuclei and moderately pale-staining cytoplasm. Some areas suggested an adenomatous arrangement and others showed a peculiar but characteristic formation of rosettes with vascular centers. Mitotic figures were rare. The cells gave the silver reaction of Masson.

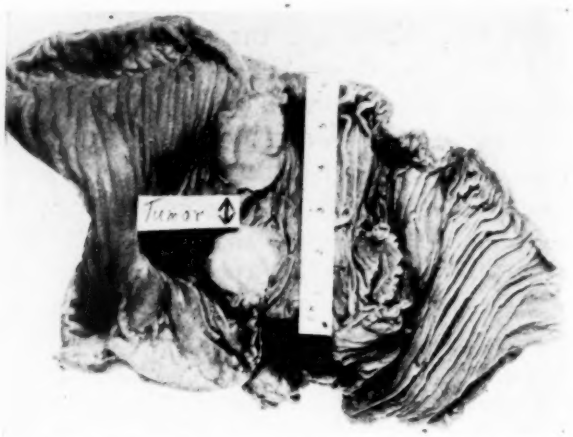

Fig. 3. Tumor occupying entire bowel wall.

Case 11. Mrs. S., female, white, aged fifty-one. Service of Dr. J. H. Woolsey.

The patient was in good health until four years before entry when she began to have a moderate distention, relieved by belching. Over the ensuing two years this symptom gradually increased and she would become extremely distended, then gain relief after a

day or two of diarrhea. The attacks, occurring at first about once a month increased in number until in the nine months prior to entry

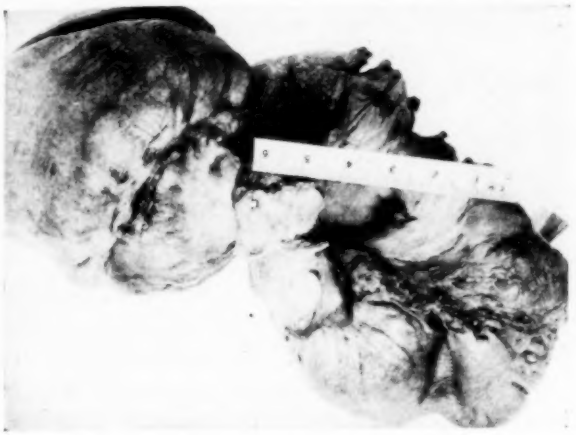

Fig. 4. Mesenteric lymph glands replaced with tumor cells.

they were occurring every two days. She began to vomit bile-stained mucus and food particles one to two hours after meals, had a persistent light brown diarrhea and a heavy midline abdominal pain which would be relieved by the passing of feces or gas. She lost 52 lb. in the last nine months of illness.

Physical examination showed a normal heart and lungs. There was visible peristalsis over the whole center of the abdomen with movements in both directions. The abdomen was spastic with moderate epigastric tenderness. A gastrointestinal *x*-ray examination showed barium in the lower ileum at twenty-four and forty-eight hours with dilatation of this part of the bowel. A small bowel distention displaced the colon.

A laparotomy was done for intestinal obstruction, and a constriction was found in the terminal ileum 26 cm. from the ileocecal valve. The bowel was widely dilated above and collapsed below this point. Thirty-five centimeters of the bowel were resected followed by lateral anastomosis. The patient recovered rapidly and has remained well for one year since operation.

The gross specimen (Fig. 3) showed the bowel wall infiltrated with tumor cells in a linear manner over a plaque 4 cm. long and running from the mesentery around the bowel for 1½ cm., thus forming a tumor plaque of roughly oval shape, ½ × 1½ × 4 cm. in size. The tumor occupied the entire bowel wall with thick cell islands in the submucous and subserous areas from which cords of similar cells extended through the muscularis. The mucosa was not eroded and the serous surface

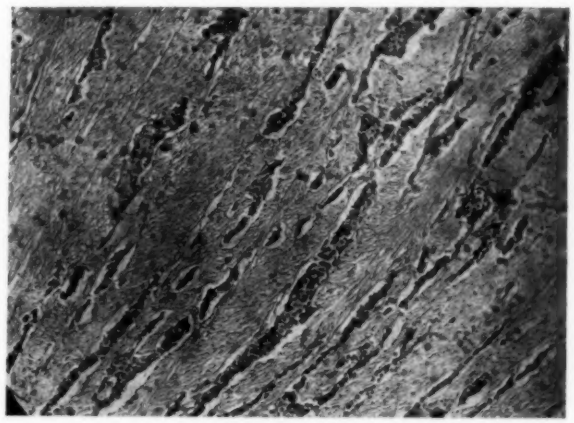

Fig. 5. Typical cells in unusually heavy stroma.

was smooth. This plaque was folded directly inward through 180° forming a shelf, projecting into the lumen of the bowel causing a partial obstruction. In the mesentery 1 cm. from its attachment were 4 glands from ¼ to 1 cm. in diameter which were replaced by tumor cells (Fig. 4).

Microscopically (Fig. 5) the tumor was composed of sheets and cords of small to medium sized cells with pale, vesicular nuclei and scant pink cytoplasm, held in a smooth muscle and fibrous stroma. They gave the silver reaction of Masson.

SUMMARY

A review of the literature shows that carcinoids of the appendix are comparatively common conditions. They occasionally invade the mesentery or even lymph nodes but have not been known to cause death. On the other hand, similar tumors of the small intestine are less common and have a higher metastatic activity. They have been known to invade the liver as well as adjacent lymph nodes. Two cases are reported in which carcinoids caused obstruction of the ileum requiring operation. Invasion of contiguous tissues and metastasis to lymph nodes occurred in one. Even after such metastasis the prognosis is good, as there is no record of postoperative recurrence.

[For References see p. 95.]

TRUCKERS' ANKLE SPRAIN*

M. B. COOPERMAN, M.D.

PHILADELPHIA, PA.

A CHARACTERISTIC sprain of the ankle and foot has often been observed by the writer among stevedores and warehouse laborers employed as truck hands. Because of the mechanism of this injury and its frequency in these workers, I have designated it "the truckers' ankle sprain." This condition arises when the foot is accidentally caught and wedged in between the platform of a four wheel hand truck and the floor and is virtually an incomplete or transient backward displacement of the foot on the leg at the ankle joint. The symptoms in some of these cases are mild and of short duration, the patient continuing at work, while in others, they are decidedly disabling in character due to the injury to the ligaments of the ankle, subastragalar joint and the adjacent tendons.

Mechanism: The ordinary four wheeled hand truck is the vehicle most employed in industrial plants to convey raw or finished products from one department to another. The capacity of this truck when fully loaded, in the plant I am making special reference to, is about 2000 lb. Two men, one at the rear pushing and the other at the front pulling, are necessary to operate this truck. If, for some reason or other, one lags and the truck gains momentum, the foot of the man who is pulling, is caught and becomes wedged in between the platform of the truck and the floor. The foot is usually in a position of plantar flexion (the heel raised and the body weight on the toes) or it may be flat upon the floor. In either event, the violence is from behind exerted upon the back of the lower leg which tends to force the foot backward and the leg forward. In the attempt to extricate it from this position, the foot will be forced sidewise and the lateral ligaments, either the internal or external, will be sprained.

The structures involved in the injury are the tendo Achilles, the tendons of the tibialis posticus and peroneus longus, the capsular and lateral ligaments of the ankle joint and the interosseous ligament between the astragalus and the os calcis. A sprain of the capsular ligaments occurs at all of its attachments to the margins of the lower borders of the tibia and the margins of attachment to the astragalus and os calcis.

The ankle mortise, consisting of the articular surfaces of the tibia and fibula, is pushed forward and it may or may not carry with it the superior articular surfaces of the astragalus. The head of the astragalus is forced downward and inward upon the scaphoid, carrying the latter with it. The strong inferior calcaneoscaphoid ligament, the long and short plantar ligaments, are strained and the foot as a whole is elongated. The midtarsals and metatarsals receive the impact and are jammed against each other. The force then is finally dissipated in the metatarsal heads and toes. Occasionally, a Stave fracture of the base of the first metatarsal may occur.

Symptoms: In the milder varieties of this sprain, when the patient can disentangle himself from the truck quickly, the symptoms are confined to the heel tendon and the lateral ligaments of the joint. These patients may continue at work for an hour or two when they develop pain and stiffness in the ankle, some swelling and tenderness along the margins of the joint and the back of the heel.

In the more severe variety, the disability is immediate, the pain in the heel, ankle and foot is intense, and the patient is unable to bear any weight. The examination shortly after the accident reveals

* Submitted for publication December 31, 1930.

diffuse swelling around the ankle joint, slight discoloration and tenderness along all the margins of the ankle joint, back of the heel and Achilles tendon. In some cases, tenderness is most pronounced along the mesial aspect of the subastragalar joint. There is moderate impairment of mobility in the ankle and the subastragalar and midtarsal joints. The *x*-ray examination is negative.

In the average case, this disability lasts from ten days to two weeks. In some instances, however, a traumatic arthritis arises in the subastragalar and midtarsal joints of the foot, characterized by pain and stiffness and moderate impairment of lateral mobility. Ankle motion, however, is not materially interfered with.

This type of injury differs from an ordinary ankle sprain in the mechanism of its production. The majority of ankle sprains, as we see them, are due to eversion or inversion twists, the weight of the body acting upon the ankle, causing the sprain. In the "truckers' sprain," however, the violence is exerted from behind and it tends to force the leg off the foot in a forward direction.

Treatment: The treatment differs very little from that of the ordinary ankle sprain. The milder variety is strapped and the patient may return to work. In the severe type, it is necessary to treat these cases as a fracture by immobilizing the foot and leg in a plaster cast, due attention being paid to a right angular and slight supinated position of the foot. At the end of ten days, the cast is removed and the extremity subjected to baking and gentle massage.

Adhesive straps are then applied which are worn for three or four days, the foot and ankle are again given baking and massage and the straps reapplied. This treatment continues for about a month. These patients usually return to work with their adhesive strapping on at the end of the second week. Pain in the heel and midfoot usually persists for some time. The average laborer, however, is not of the neurotic type and soon forgets his indisposition.

A few cases tend to pursue a chronic course characterized by pain and stiffness in the foot. Lateral motion is restricted by adhesions which have formed in the subastragalar and midtarsal regions, the foot being in rigid abduction. The *x*-ray may show osteoarthritic changes in these joints.

To effect a cure, I have had to resort to manipulations under an anesthetic to break down adhesions and restore normal statics. A Whitman arch brace is then made on a plaster of Paris model of the foot in the corrected position which the patient wears for an indefinite period of time.

BREECH PRESENTATION IN PRIMIPARAE*

ALEXANDER E. DUNBAR, M.D.

BROOKLYN, N. Y.

ONE of the most important and potentially formidable situations which confronts the obstetrician is the breech presentation in the primiparous woman. The accoucheur must realize that there are certain well-defined reasons for careful and thoughtful management of this situation: (1) prolonged labor due to premature rupture of the membranes, thus making the breech a poor dilating wedge; (2) intelligent management of the cord and the arms; (3) last but not least, is the management of the after-coming head.

Let us review the result of five years' work at the Methodist Episcopal Hospital, 1924–1928 inclusive. In this series there are 135 cases of breech in primiparous women.

Private Cases	75
Ward Cases	60
Positions:	
Left sacrum anterior	72
Right sacrum anterior	45
Left sacrum posterior	12
Right sacrum posterior	6
Condition of the membranes on admission:	
Intact	82
Ruptured	53

Over 50 per cent of the cases which had membranes intact, ruptured very shortly after admission to the hospital.

The shortest period of rupture before delivery 15 minutes.

The longest period of rupture before delivery 8 days.

The duration of labor varied from two hours to eight days, the average being twenty-four hours.

Types of Pelvis:	
Normal	85
Generally contracted	10
Funnel	25
Flat	13
Generally contracted funnel	2
Types of Breech:	
Frank breech	114
Footling	15
Double footling	6
Procedures:	
Delivery	
(1) Spontaneous	85
(2) Breech extraction	50

The breech extraction varied from a simple pulling down of a foot which presented itself at the vulvar orifice to the most difficult procedure of pulling down one or both feet from the interior of the uterus. In two instances, extraction was performed by applying forceps directly to the breech.

Complications:	
Nuchal hitch	4
Cord between legs	2
Prolapsed cord	1
Other Maneuvers:	
Manual dilation of the cervix	5
Dührssen's incisions of the cervix	1
Separation of a vaginal septum	1
The Perineum:	
No laceration	3
First degree laceration	8
Second degree laceration	11
Third degree laceration	8
Extension from lateral episiotomy	2
Extension from median episiotomy	6
Right lateral episiotomy	82
Left lateral episiotomy	12
Median episiotomy	19

In 81.5 per cent of the cases, some type of episiotomy was used.

Forceps: The Piper type of forceps was used in the majority of the cases requiring such in the delivery of the after-coming head. In 32 cases or 23.7 per cent, forceps were required. Craniotomy was done twice in macerated feti.

In 1 case of this series abdominal cesarean section was employed as the procedure of election rather than of necessity.

Morbidity: There were 15 cases in this series which showed morbidity. It might be here stated that the majority of these cases were delivered before the vaginal antiseptic, mercurochrome, came really into its own. The morbidity percentage

* Submitted for publication December 10, 1930.

was 11.11 per cent and can be detailed as follows:

Sapremia	1
Lochiametra	7
Parametritis	1
Pyelitis	1
Infected perineum	1
Subinvolution	1
Causes unknown	3

Mortality: Maternal: None of these mothers died as a result of this type of case.

Fetal: 17 or 12.6 per cent

Still-births	9
Intracranial hemorrhage	6
Placental separation	1
Macerated fetus	2
Died after delivery	5
Intracranial hemorrhage	4
Gastrointestinal	1
Monstrosities	3
Spina bifida	1
Evisceration	1
Osteogenesis imperfecta	1

The corrected mortality for this series is 9.78 per cent.

Six of the babies that lived showed definite signs of cerebral irritation but recovered, apparently, without any definite damage.

On investigating the reports of other clinics, we find that we are doing as well as any of them and better than most of them.

Why is the breech presentation in the primiparous woman a great problem to the obstetrician?

The breech is a soft mass which does not dilate the cervix well due to its consistency and its lack of weight. The breech predisposes to a premature or an early rupture of the membranes, thus taking away the natural hydrostatic dilator. Labor is most commonly prolonged because of these facts. While the pains may be present in frequency, they do not have sufficient power to drive the baby through the pelvis as well as the vertex. Draining off of the liquor amnii is usually greater, thereby allowing the uterus to wrap itself around the baby and thus inhibiting the progress of labor. The breech does not engage well and we find many arrests of the breech high in the pelvis, thus necessitating delivery from that point. Particularly is this true in the cases of abnormal pelvis. We see from our study that 40 per cent of the cases require interference. The resistance of the undilated pelvic floor adds still another factor in slowing up the advance of the breech.

When the breech has been born to the umbilicus, the cord begins to play an important part. Compression of the cord may do serious damage to the baby at this time. It is now pulled down a short way to relieve this pressure.

The arms may present further difficulty. It is hoped that these have maintained their normal relation. Valuable time may be lost if one or both arms are extended or if there is a true nuchal hitch.

The after-coming head usually presents the greatest amount of difficulty. We have here a head which has not been molded by the process of labor. It may therefore engage in the pelvis in faulty flexion, and give rise to difficult delivery.

Technique: Our policy of procedure has been one of "Hands off." Our worst enemy is the undilated cervix. When a case is progressing in a normal way and the breech presents itself, crowning, the obstetrician may assist its progress by lightly anesthetizing the patient. The perineum is thoroughly ironed out as Irving W. Potter of Buffalo, teaches. Also, if extra room is to be required, an episiotomy, preferably a lateral one, is done. The patient is allowed to recover from the analgesia and proceeds in labor until the breech is borne up to the umbilicus. The cord is then pulled down. The baby is now rotated so that the back lies under the subpubic angle. Gentle traction is made down toward the floor until the scapulae can be seen. In rotating the back under the subpubic angle, the shoulders are released, preventing the extension of the arms, or if they have not been released, they can be more readily freed from this position. Either arm may now be delivered ante-

riorly. If the left arm is to be delivered, the baby is rotated to the mother's left 90°. The arm will be seen to drop down under the subpubic angle. Gentle pressure in the elbow will bring down the entire arm. To deliver the other arm, the baby is rotated 180° in the opposite direction and the arm is delivered by gentle traction in the elbow.

This brings us to the delivery of the head. It is at this point that the intelligent use of suprapubic pressure may be of value. With this aid, the finger is inserted into the baby's mouth, *merely to maintain flexion* and *not to be used as a tractor.* The body is held up with the other hand while the arms are held above it by an assistant. The body should not be extended over on to the abdomen, for fear of rupturing the falx cerebri or the tentorium cerebelli. Gradually the head is being born. By using a perineal retractor, the mouth is exposed a little sooner, and mucus can be sucked out of the mouth. This aids the child in getting air earlier and delivery does not have to be rushed.

Where the case is arrested Piper and Bachman, in a recent paper, feel that the breech should not be allowed to go along undelivered, fully realizing the difficulties of an incompletely dilated cervix. If the cervix is not completely paralyzed, it may clamp down around the neck. In order to offset this difficulty, the patient is completely anesthetized to the degree of deep surgical anesthesia. The hand is then passed up into the uterus, care being taken to keep away from the placenta and the cord. The breech is then decomposed by bringing both feet down, treating it then as a double footling. Traction is made so that when the buttocks reach the pelvic floor they are practically sitting in the hollow of the sacrum. From this point the fetus is rotated anteriorly so that the back lies up under the subpubic angle before any further traction is made. The remainder of the procedure is as before described.

In 3 of the 32 cases in which the Piper forceps were used we found that the babies died, one as a still-birth and two died within a few days after delivery, as a result of an intracranial hemorrhage. In 2 other cases we found two babies that presented signs of cerebral edema. Piper and Bachman feel that their specially devised instrument should be routinely used, fully realizing that the said forceps are of little or no value if the after-coming head is arrested above the pelvic brim. I do not believe that any type of forceps should be used routinely in the treatment of the after-coming head.

In our clinic we have felt that the policy of "Let nature take its course" is the wisest one. We have not used hydrostatic bags, bougies or other means to hasten the labor in women who have a breech presentation and are having a prolonged labor. Our greatest fear is undilated cervix. By "keeping hands off" we feel that our results compare favorably with those of other clinics. In prophylaxis of this situation we have felt as J. O. Polak says, "it would have been a head if it could have been a head." We therefore have not adopted external version as a prophylactic measure.

Conclusion:

(1) Hands off the breech.

(2) Our worst enemy is the cervix. Give it time to dilate.

(3) Cases of markedly abnormal pelvis with oversized babies, and elderly primiparae should be treated by cesarean section.

(4) Where there has been an arrest after full dilation patients should be surgically anesthetized, the soft tissues thoroughly dilated, plus episiotomy and a careful extraction should be done.

(5) Breech cases should at all times be in the hands of the trained obstetrician.

PORRO CESAREAN SECTION

(CESAREAN SECTION FOLLOWED BY SUPRAVAGINAL HYSTERECTOMY) A REVIEW OF 25 CONSECUTIVE CASES WITHOUT MATERNAL MORTALITY*

LOUIS E. PHANEUF, M.D., F.A.C.S.

BOSTON

ACCORDING to Williams,[1] the history of cesarean section may be said to cover five distinct periods. The first period dates from the earliest times to the beginning of the sixteenth century. The second period extends from 1500 to 1876. The third period begins with the introduction, by Porro, of the amputation of the body of the uterus. The fourth period starts in 1882 following the description, by Saenger, of an accurate technique for suturing the uterine incision and continues to the present time. Finally the fifth period saw its origin when Frank devised the extraperitoneal technique.

During the first two periods, cesarean section was only done when all other methods of delivery had failed, as a result of which the mortality was frightful. This high mortality was due to sepsis or hemorrhage or both. In order to lessen these disastrous complications, Porro, of Pavia, in 1876, advised the amputation of the body of the uterus and the adnexa above an elastic ligature, wound around the cervix and the suturing of the cervical stump at the lower angle of the abdominal incision. DeLee,[2] states that the operation had been suggested by Cavallini in 1768 and performed successfully on rabbits by Blundell in 1823. Storer of Boston, in 1861, amputated a pregnant myomatous uterus with fatal result. Inasmuch, however, as he did not appear to recognize the importance of this intervention, the credit for proposing it undoubtedly belongs to Porro. Later, when Schroeder dropped the sutured hysterectomy stump back into the pelvis, Isaac E. Taylor did the same for the stump after Porro's operation.

With the advent of the Porro operation the mortality of cesarean section was greatly reduced. Its great drawback was that it was so radical. When, in 1882, Saenger described his technique of suturing

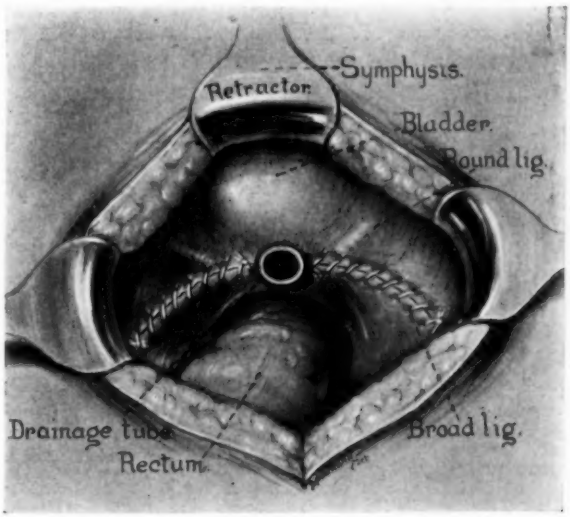

FIG. 1. Porro cesarean section completed. In this case the adnexa have been removed. Round ligaments have been sutured to cervical stump. Rubber drainage tube has been introduced in cervix. All raw areas in pelvis have been covered with peritoneum.

the uterine incision, he made one of the greatest, if not the greatest contribution to cesarean section. Saenger's operation was responsible for limiting the Porro procedure to those cases where a definite indication for sacrificing the uterus existed.

The contribution of Frank, when he advocated the extraperitoneal technique, still further limited the indications for the radical method of Porro.

The present-day indications are (1) sepsis in labor when vaginal delivery is undesirable, (2) in the presence of myomata, especially if large or situated ahead of the presenting part thus obstructing labor, and (3) in severe hemorrhage from placenta previa, ablatio placentae and uterine apoplexy, "Couvelaire uterus." (4) Cancer of the cervix, osteomalacia, placenta accreta, uncontrollable post-partum hemorrhage and rupture of the uterus are rarer indications for hysterectomy.

[1] Williams. Obstetrics. Ed. 6, N. Y., Appleton, 1930, pp. 530–533.

[2] DeLee. Principles and Practice of Obstetrics. Ed. 5, Phila., Saunders, 1929, pp. 1071–1073.

* Submitted for publication March 6, 1931.

No. of Pregnancies

Para I	9
II	8
III	2
IV	1
V	3
XI	2
Total	25

Indications

Mismanaged labor and frank infection	7
Uterine myomata	7
Pathological uterus from improperly healed previous classical cesarean section scars	2
Uncontrollable hemorrhage during cesarean section	4
Premature separation of placenta and uterine apoplexy	3
Firmly adherent placenta, anterior uterine wall thinned out to peritoneum, 4 previous manual extractions of placenta	1
Hernia of gravid uterus, previous classical cesarean section, edges of incision held only by peritoneum	1
Total	25

Labor

Ten of the gravid patients had had labor. 64 hours, 1; 48 hours, 2; 25 hours, 1; 18 hours, 1; 16 hours, 1. In labor for many hours, the exact number not determined 4.

Vaginal Examinations

Several vaginal examinations had been made in 4 of the patients. In one a bag had been in the uterus five hours; in another, there had been seven attempts at forceps before admission.

Transfusion

Two patients in the series were transfused, one for hemorrhage was given 600 c.c. of citrated blood, the other for anemia of pregnancy was given 400 c.c.

Ruptured Membranes

The membranes were ruptured in eight patients, the longest being seventy-two hours.

Maternal Results

All the mothers recovered. The postoperative complications were: two very septic incisions breaking down to the fascia in 2 infected cases; these patients were discharged with healed incisions. There was superficial sepsis around the abdominal drains in the drained cases; these cleared up readily after the removal of the drains. One patient had a pelvic abscess drained twenty-five days after operation by posterior colpotomy. The original operation had been done for a fibroid previa in a clean case and the cervix and abdomen had been closed without drainage. The convalescence was remarkably simple in this series of cases despite the fact that many of the patients were poor risks.

Fetal Mortality

Twenty-five children were delivered, 3 were dead before the operation was undertaken and 1 born alive did not survive, a gross fetal mortality of 16 per cent. Of the 22 children born alive 1 died, a corrected fetal mortality of 4.5 per cent.

Stillborn—3

Mother had separation of the placenta and uterine apoplexy 2

Cerebral injury; 7 attempts at forceps .. 1

Fetal Death—1

Died on the fifth day, hemorrhagic disease and infection. Septic case, labor sixty-four hours, free pus in utero ... 1

Anesthesia

Spinal anesthesia	4
Nitrous oxide, ether anesthesia	21

Type of Hysterectomy

Panhysterectomy	1
Supravaginal hysterectomy	24

Adnexa

Conservation of both adnexa	9
Conservation of right adnexa	1
Ablation of both adnexa	15

Ages

Years	No.	Years	No.
22	2	35	2
23	1	36	2
29	2	37	2
30	2	38	1
31	1	40	3
33	2	42	1
34	3	44	1

Total 25

SUMMARY AND COMMENT

While it should be the aim of the gynecologist and obstetrician to conserve the organs of reproduction during the childbearing age, there are certain conditions arising during parturition which may threaten the mother's life and which demand their sacrifice. With the improvement in the technique of cesarean section, especially since the more general adoption of the low or cervical procedure, the indications of the Porro operation have become greatly limited. Despite this fact, there will probably always be an occasional case when this method is a life-saving one. Twenty-five consecutive Porro cesarean sections are reported, without maternal mortality, with a gross fetal mortality of 16 per cent and a corrected fetal mortality of 4.5 per cent. The technique of the operation is simple. Drainage, through the cervix, seems advisable, even if not absolutely necessary, in most cases. The convalescence is remarkably simple when we take into consideration that this operation is usually done on septic women, and on those who have lost considerable blood.

PRIMARY STRICTURE OF THE COMMON BILE DUCT (NON-MALIGNANT)*

LOUIS FRIEDMAN, M.D.

NEW YORK

PRIMARY inflammatory stricture of common bile duct is comparatively rare, of the hepatics more so, though not vertical as is the tendency to do, so that the tube emerges at the lower angle of the wound not at the upper angle. It is

FIG. 1.

FIG. 2. Lipiodol in sinus tract. Stomach, duodenum, liver radicals.

Eliot quotes statistics from the Mayo Clinic which showed that 18 of 38 cases had no primary operations.

The operative management, where plastic reconstruction of the common bile duct is not feasible either in primary stricture or postoperative injury, is as follows: Preoperative preparation of patient for the existing cholemia. Spinal anesthesia preferable. Exploration. Finding of stricture or injury to common bile duct, introduction of drainage tube (14–15 French size) into dilated portion of common bile duct above the stricture. It is important in instituting this drainage that the tube used shall be as nearly horizontal to the axis of the spine as possible, important to keep away from the liver or gall-bladder bed if this has to be removed, as far as possible so that the subsequently formed biliary sinus tract shall have no liver substance as part of its wall.

The only portion of the fistulous tract which can be utilized and cored out for anastomotic implantation is that portion extending from the skin surface to and only very little distance beyond the peritoneum. It is inadvisable to attempt to separate the fistulous tract beyond the peritoneum for the reason that in attempting to do so injury to the sinus tract may be done in separating adhesions. If the liver is a part of the sinus tract, care must be taken in dissecting and coring out the tract; the

* Submitted for publication December 6, 1930.

slightest nick in its attachment to the liver, part of the tract, will result in partial (as in my case) or total failure due to

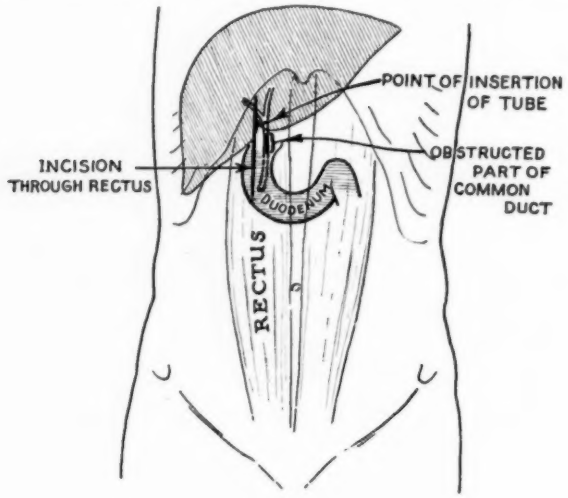

FIG. 3.

subsequent leak and bile drainage. The tract should be cored out with as much thickness of surrounding structures as possible so helping its blood supply as well as its rigidity. The fistulous tract is usually not long. In the case here reported, it was not longer than ¾ in. Difficulty in implanting can be avoided by having a longer tract. In order to obtain this, it is necessary to place the drainage tube horizontal to the body axis and then following the suggested steps for the formation of the sinus tract, part of the wall of which will be fascia, as illustrated.

The time for performance of the second stage of the operation, that is, the implanting of the sinus tract, will depend upon the judgment of the surgeon and the general condition of the patient. Primary union of the wound is essential for a subsequent well-formed tract. The patient should be entirely free from jaundice, Van den Bergh test normal, and the patency of the sinus determined, by withdrawing the drainage tube after healing of wound, allowing bile drainage without tube for a week or ten days. In coring the sinus, allow at least ¼ in. of skin surface with the sinus, to act as a retention catheter would.

CASE REPORT

Julius Miller. No. 6044. Age, sixty-four.
Chief Complaint: Jaundice.

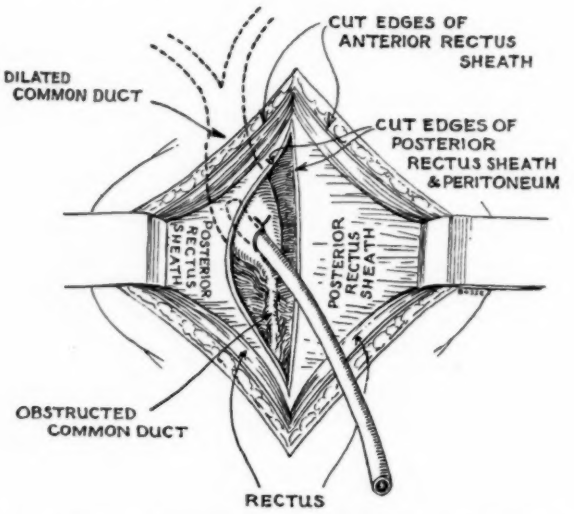

FIG. 4. Step 1. Insertion of tube into dilated portion of common duct above stricture.

Family History: Negative.
Past History: Negative.
Present Illness: Jaundice for four weeks; onset gradual, not associated with pain; no fever; some belching; nausea but no vomiting. Stools became clay colored and urine consistently darker. Increasing jaundice, severe itching.

Physical Examination: Patient is an adult white male, sixty-four years of age, Skin jaundiced. Sclerae jaundiced. Eyes: Pupils equal, regular, react well. Heart: Normal. Lungs: Normal. Abdomen: Liver palpable four finger breadths below costal margin. Spleen not palpable. Kidneys not palpable.

Impression: Carcinoma of pancreas?

Admitted to Medical Ward for observation and later transferred to Surgical Service under the care of Dr. Friedman who found the patient deeply jaundiced. Mass in right hypochondrium, somewhat tender, suggestive of distended gall bladder. Diagnosis: cholecystitis. Cholangitis and possible carcinoma of head of pancreas. Advised operation.

Operation, Sept. 25, 1928: the abdomen was opened by a right upper quadrant incision. Gall bladder found to be distended, containing white bile. In other words, hydrops of gall bladder. Cholecystectomy. Cystic duct was found to be obliterated and this obliteration continuous with the common bile duct giving

the impression of a stone in the common bile duct. Incision, however, of this mass proved that it was only hard cicatricial tissue which caused complete obstruction of common bile duct with considerable distention of the duct above site of constriction. Attempt to pass a fine probe through the constricted common bile duct and into duodenum was not successful. The duct above the constriction was opened and bile obtained under great pressure. Tube introduced into common bile duct above constriction for drainage. Usual closure of abdominal wound.

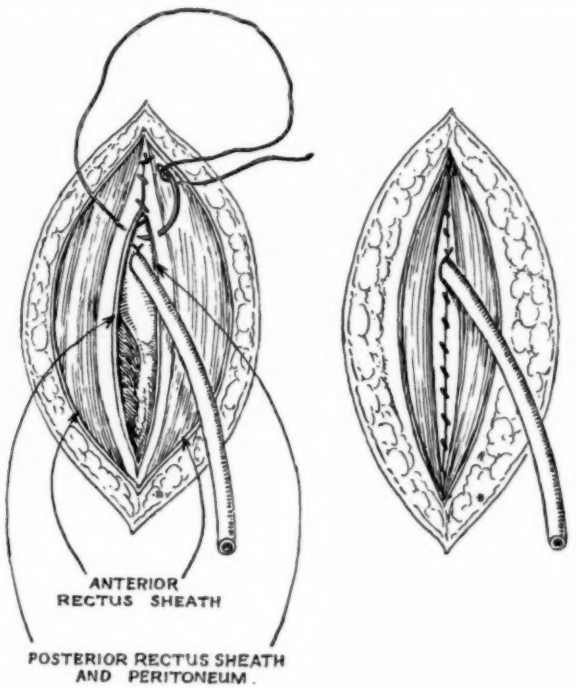

Fig. 5. Step 2a. Suture peritoneum and posterior rectus sheath. Note horizontal portion of drainage tube. b. Peritoneum and posterior rectus sheath closed.

Postoperative course uneventful. Patient began to drain bile after a number of hours through the tube. Jaundice gradually cleared up.

Urinary Examinations:

Sept. 10, 1928. Specific gravity 1028. Bile in urine. Trace of albumin. Trace of urobilinogen. Few casts.

Sept. 11, 1928. Bile 2+.

Sept. 10, 1928. Blood count, red blood cells 4,320,000. Hemoglobin, 80 per cent. White blood cells 6000. Coagulation time five minutes. Bleeding time two minutes.

Urea N. 16.2. Glucose 160. Van den Bergh indirect 8, direct 8.

Sept. 11, 1928. Wassermann test negative. Gastric contents, blood negative. Bile negative.

Sept. 12, 1928. Van den Bergh Indirect 9.0. Direct 4+.

Sept. 13, 1928. Cholesterin 167. Gastric contents: bile present in both specimens.

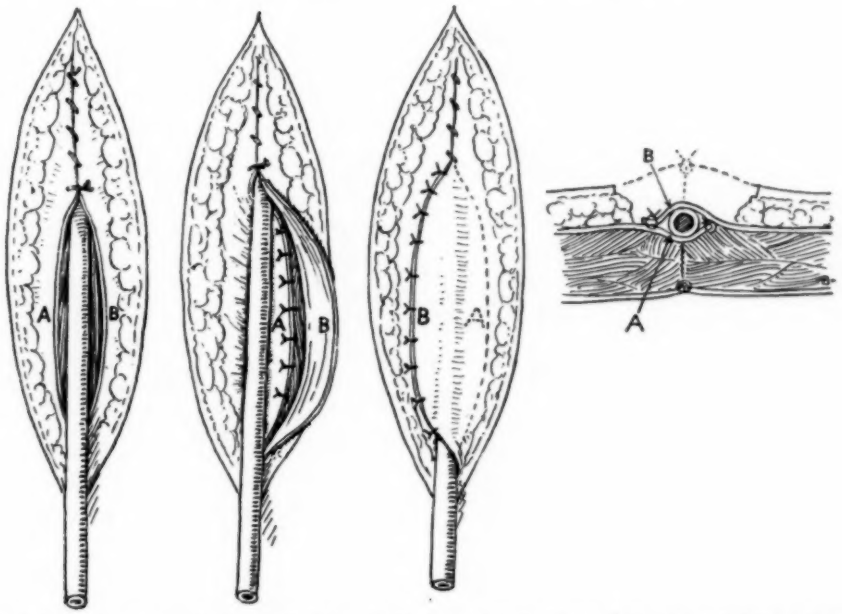

Fig. 6. Step 3. Method of constructing fistula tract utilizing anterior rectus fascia. Mobilize fascia, by dissecting from rectus muscle; avoid tension. Use chromic catgut.

Sept. 14, 1928. Bile before magnesium sulphate 3. After magnesium sulphate. Van den Bergh indirect 6. Direct 3+.

Sept. 17, 1928. Van den Bergh indirect 4. Direct 3.

Sept. 19, 1928. Gastric contents, bile 4+ in

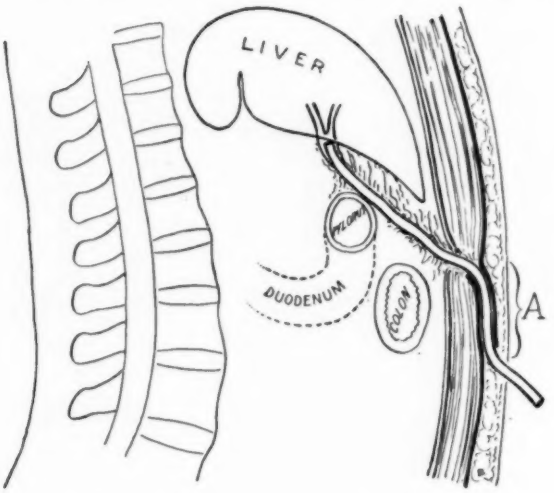

Fig. 7. A. Extent of channel made from anterior rectus fascia. Length depending on individual judgment. Showing drainage tube as nearly horizontal to body as possible; staying away from liver bed.

both specimens. Blood chemistry: Van den Bergh indirect 4. Direct 2+.

After drainage instituted.

Oct. 4, 1928. Van den Bergh 2.3. Direct 1+.

Oct. 11, 1928. Van den Bergh indirect 1.5. Direct negative.

Oct. 29, 1928. Urea nitrogen 21. Creatinine 1.5. Glucose 130.

X-ray examination Sept. 17, 1928. Gall bladder with dye after twelve, fifteen and eighteen hours not visualized. Thirty-six hour examination after fatty meal did not visualize gall bladder.

Pathological Examination: Sept. 25, 1928. Specimen consists of a gall bladder 8 × 3 × 3 cm. Wall quite thickened, filled with scattered cysts. Mucosa is thickened, reddish and yellowish in color; shows areas of brownish discoloration at fundus.

Histological Examination: section shows almost complete atrophy of mucosa, thick fibrous connective tissue through. Thickened vessels with moderate edema.

Diagnosis: Chronic productive cholecystitis.

The patient left the hospital with a biliary fistula. Reentered the hospital again Jan. 31, 1929.

Physical Examination: Patient fairly well nourished, not jaundiced. Abdomen: has persistent biliary fistula, otherwise no pain anywhere.

Operation: Feb. 8, 1929. Under spinal anesthesia, fistulous tract was dissected down to peritoneum. Fistula was inadvertently nicked

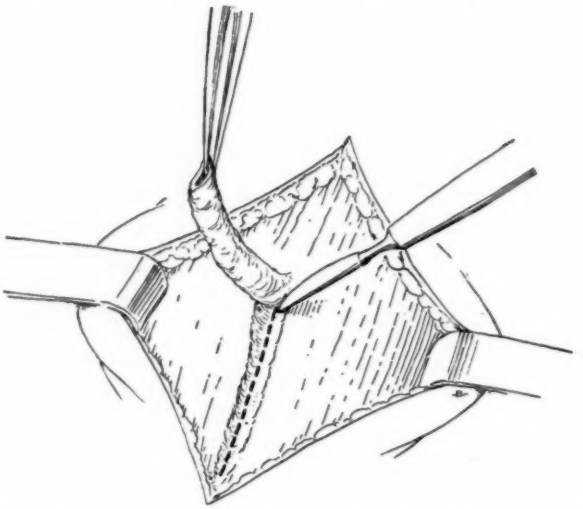

Fig. 8. Step 4. Second operation. Coring out fistula tract for implantation.

at its contact with the liver. It was immediately sutured with chromic catgut. The duodenum was buried in dense adhesions and because of shortness of biliary fistula it was deemed advisable to implant it into the stomach rather than into the duodenum. The stomach was delivered, opened, postpyloric. Tract was placed into the opening, first sutured posteriorly then anteriorly with interrupted silk. Omentum was used to cover anterior sutures. Piece of rubber dam placed posteriorly and abdomen closed.

Postoperative progress fairly normal. First dressing Feb. 12, 1929. Rubber dam drain removed. Slight amount of serous discharge present.

Feb. 13, 1929. Van den Bergh indirect 1.4. Direct negative.

Feb. 18, 1929. Convalescence normal.

Feb. 22, 1929. 4 P.M. Patient had chill. Temperature 103°F. Considerable râles in chest. *Stool good color.*

Feb. 26, 1929. Wound inspected. All sutures removed. Primary union of wound. Fistula anastomosis evidently working well. *Stools yellow.* Sclerae very slightly icteric. Van den Bergh normal. Patient out of bed.

March, 1, 1929. Temperature 101°F. Moderate tenderness in upper angle of wound.

March 2, 1929. Upper angle of wound reopened. Slight amount of bile appeared on dressing, most likely coming from that part

of sinus tract which was nicked at time of operation. Following this from time to time considerable bile discharged from wound.

March 19, 1929. Biliary fistula draining just as much as before operation. Patient somewhat better. Lipiodol injected and *x*-rays taken.

Lipiodol injected and *x*-rays taken. *X*-rays show primary biliary fistula implantation open and functioning. The lipiodol is seen to be present in the stomach.

Until the patient left the hospital biliary drainage through this fistula stopped and started on and off several times.

March 9, 1929. Bile drainage has ceased since last Friday. Previously drainage has been very slight. Stools are yellow since drainage stopped.

Readmitted Jan. 30, 1929. Stools acholyc. Second operation Feb. 8, 1929.

Feb. 9, 1929. Vomited large amounts of green fluid. Stool yellow.

Feb. 13, 1929. Stool yellow. Postoperative showing fistula anastomosis functioning.

Feb. 14, 1929. Stool yellow. Postoperative showing fistula anastomosis functioning.

Feb. 19, 1929. Brown formed stools. Postoperative showing fistula anastomosis functioning.

Feb. 22, 1929. Yellowish brown stools. Postoperative showing fistula anastomosis functioning.

Feb. 28, 1929. Yellowish brown stools. Postoperative showing fistula anastomosis functioning.

March 1, 1929. Following chill, vomited yellowish green fluid, like bile. Fistula draining again.

March 5, 1929. Stool light brown.

March 8, 1929. Stool light green. Fistula draining very little.

March 9, 1929. Stool brown.

March 11, 1929. Stool light brown. Fistula draining.

March 12, 1929. Stool light brown. Fistula draining.

March 13, 1929. Stool very light. Fistula draining.

March 14, 1929. Stool very light. Fistula draining.

March 18, 1929. Stool light brown.

March 20, 1929. Stool light yellow.

March 22, 1929. Free drainage. Bile salts three times a day.

March 24, 1929. Stool light brown.

March 26, 1929. Stool dark brown. Drainage moderate.

March 27, 1929. Stool dark brown.

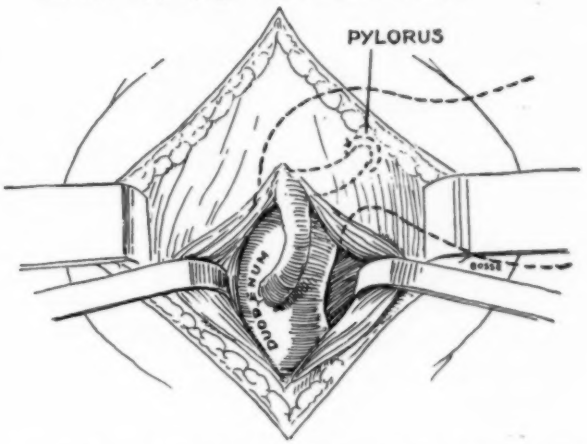

Fig. 9. Second operation. Implantation of fistula tract either into pylorus or duodenum. Witzel method.

March 28, 1929. Stool yellow.

March 29, 1929. Stool-light greenish.

April 2, 1929. Stool light brown.

April 30, 1929. Stool clay color.

X-ray examination, March 14, 1929, of abdomen after injection of sinus tract with iodized oil shows the following: The oil is entering the hepatic ducts with some oil entering the duodenum and stomach.

Comment. It is interesting to note that for almost three weeks the fistula was functioning with bile entering into the stomach and duodenum as proved by the color of stool. If not for the unfortunate accidental nicking of fistulous tract at its junction with the liver bed, secondary biliary fistula would not have formed and anastomosis with proper bile drainage into the stomach would have been possible. It is also interesting to note that during the periods of closure of fistula which occurred from time to time following the operation, the stools again became colored as per dates mentioned proving again that the fistula gastric anastomosis was functioning. However, later the drainage of bile continued through the fistula in the abdominal wall and because of the condition of the patient it was not advisable to operate so he was discharged.

August 2, 1929. *X*-ray examination of biliary fistula injected with lipiodol showed the following: Moderate number of biliary ducts to be filled. There are two small dilatations, one measuring about ¾ in. in length and the other ½ in. seen in the region of the common duct. Lipiodol passes readily into the duodenum.

Patient died Oct. 7, 1929.

INFLAMMATORY OBSTRUCTION OF THE URETER

CAUSED BY PSOAS ABSCESS, SECONDARY TO TUBERCULOSIS OF THE SPINE*

GILBERT J. THOMAS, M.D., F.A.C.S., AND THOMAS J. KINSELLA, M.D., F.A.C.S.

MINNEAPOLIS, MINN. OAK TERRACE, MINN.

AT Glen Lake Sanatorium, the Hennepin County institution for the treatment of tuberculosis, new data concerning the diagnosis and treatment of tuberculosis, together with many unusual pathologic specimens, are reported each year.

Patients sent to Glen Lake Sanatorium, where all types of tuberculosis are treated, sometimes remain for many years. This permits us to make repeated examinations, and to watch lesions in the genitourinary tract over long periods of time. In an attempt to evaluate our clinical findings and data obtained from urologic study, a post-mortem examination is made, whenever possible. Gross specimens of the urinary organs are always saved for study, whether the patient has had genitourinary symptoms or not. This routine post-mortem examination of the urinary organs has been enlightening.

We are reporting herewith the histories and post-mortem findings of two patients who had obstructions in their ureters which were the result of psoas abscesses originating in tuberculosis of the vertebrae. The obstruction was complete enough to destroy the kidney entirely in one instance, and to produce a large hydronephrosis in the other. In neither was the unusual pathology suspected, and would not have been discovered without a post-mortem examination.

CASE REPORTS

CASE 1. A woman, aged thirty-nine years, whose history indicates that at the age of twenty-one she had her first illness, an abscess developing over the spine. This opened spontaneously, but drainage was not sufficient and eventually a rib resection was done. For a time this sinus closed, and then a kyphosis developed.

No trouble was observed for three years. Then she complained of pain in the right side of the back with some radiation to the right abdomen. The patient had an appendectomy which gave no relief from this pain, and left a gaping, infected wound which did not heal for several months.

During the patient's convalescence from the appendectomy, another abscess developed in her back which required multiple incisions in order to improve the drainage. Chronically draining sinuses resulted which continued for many years.

In September, 1927, the patient had a severe cold, followed by a persistent cough. This continued until her admission to the sanatorium in April, 1928. At this time a thorough examination revealed the following lesions: (1) tuberculosis of the sixth to the twelfth dorsal vertebrae, with draining tuberculous sinuses from the right posterior chest wall; (2) pulmonary tuberculous with empyema, right side; (3) some free fluid in the peritoneal cavity, probably peritonitis.

Repeated inoculations of the urine into guinea pigs were negative for tuberculosis.

Post-mortem examination, made two years following the patient's admission to the sanatorium, revealed the following: There were several sinuses, one about 3 cm. below the right nipple, another 8.5 cm. below the crest of the left ileum and 10 cm. posterior to the anterior superior spine. There were five scars of healed sinuses in the skin of the back.

An old pulmonary tuberculosis with empyema was found in the right chest. A chronic tuberculous peritonitis was present and there was a tuberculosis of the fourth dorsal to the third lumbar vertebrae with multiple sinuses. The right kidney, which was normal in size and weight, was bound down by firm fibrous adhesions. These were noticeable on the medial and anterior portions. Except for these

*Read at the 42nd Annual Meeting, American Association of Genito-Urinary Surgeons, French Lick, Ind., May 22–24, 1930.

adhesions, the right kidney and ureter seemed to be normal.

On the left side there were many adhesions which involved the entire kidney and the first 4 cm. of the left ureter. This kidney was markedly atrophic. There was a hydronephrosis which was produced by contraction of scar tissue about the upper ureter. Inspection of the left ureter below the obstructed area was negative. There was no gross or microscopic evidence of tuberculosis in either kidney. A sinus tract was discovered on the left side which began at the eleventh dorsal vertebra and extended to the scar tissue surrounding the left upper ureter and kidney. This was followed laterally and was lost over the left psoas muscle.

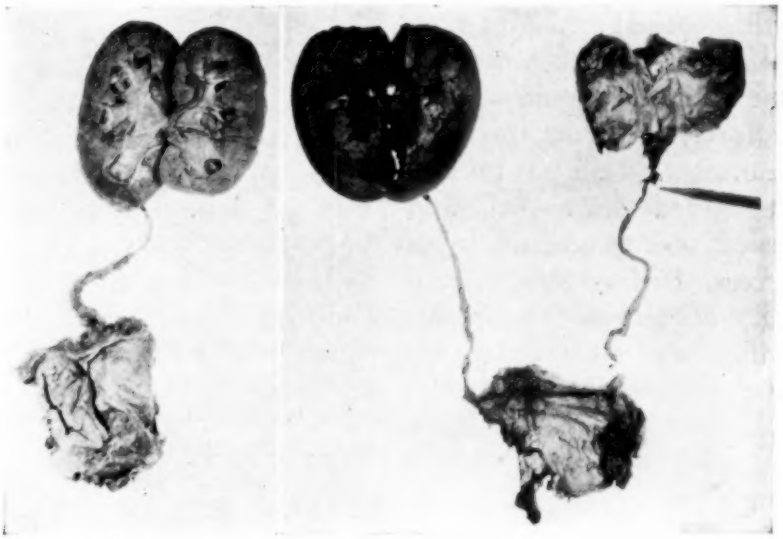

Fig. 1. Fig. 2.

Fig. 1. Hydronephrosis produced by obstruction in upper ureter, result of psoas abscess.

Fig. 2. Kidney totally destroyed. Hydronephrosis with obstruction in ureter near kidney the result of psoas abscess, opposite kidney normal.

We reviewed the nurse's record and the patient's complaints appearing in the history and progress record without finding mention of attacks of pain which might be interpreted as coming from some condition obstructing the left ureter. Since this patient had back pain continuously because of the tuberculosis of the vertebrae, it is easy to understand why this symptom may have been misinterpreted.

Case II. The second patient was a male, aged twenty years, who was admitted to the sanatorium April 22, 1927, and died August 31, 1927, berng under our observation for only four months.

On admission we found that this man had a bilateral parenchymal pulmonary tuberculosis, more noticeable on the right side than on the left. He had a positive sputum. Two months after admission he had a contracture of the left thigh and a palpable mass in the left abdomen. For several weeks before this abdominal mass was noted, the patient had complained of pain in the left leg and the left lumbar region. He had no genitourinary complaints. Urinalysis of ten specimens of urine revealed only a faint trace of albumen. Only one contained a few leucocytes. Repeated Ziehl-Neelson stains and frequent injections of urine into guinea pigs did not reveal evidence of tuberculosis.

A roentgenogram of the lower dorsal and lumbar spine showed marked destruction of the lower portion of the first and third lumbar vertebra with bilateral psoas abscess.

A post-mortem examination was made one hour following death. The anatomical diagnoses were Pott's disease of the lumbar spine, miliary tuberculosis of the lungs, kidneys and adrenals, with caseous tuberculosis of the lungs and adrenals. There was slight dilation of the pelvis of the right kidney and there were many tubercles scattered throughout its cortex. The ureter on the right side was not involved in an inflammatory mass. On the left side there was marked dilatation of the pelvis of the kidney. The ureter was caught in a fibrous

tissue mass which was part of a psoas abscess constricting the ureter and producing a hydronephrosis.

A review of this patient's history does not reveal complaints, symptoms or findings which might indicate a genitourinary lesion. Like the former patient, this man had a great deal of pain on the left lumbar region which extended downward, and which we believed was produced by a large psoas abscess. If this patient had pain as a result of obstruction in his ureter, it probably was masked by the pains which were produced by the tuberculosis in the spine and the psoas abscess. We do not know why the abscess on the right side did not involve the right ureter. We are unable at this time to find an anatomical reason why the left, and not the right ureter should be involved, particularly in the last case, where bilateral psoas abscess were discovered.

It seems evident from these reports that psoas abscess may involve the ureter, producing obstruction and thus destroying the kidney. In the cases which we report, this obstruction in the ureter was not associated with tuberculosis of the kidney. Urinary findings were negative. The history was not helpful in making a diagnosis of ureteral obstruction.

The conditions found had not been anticipated, and only the post-mortem study made the true diagnosis possible. We shall consider, however, the possibility of obstruction of the ureter in all future cases of psoas abscess.

These reports are made with the cooperation of Drs. C. C. VanWinkle and L. E. Williams, pathologists at Glen Lake Sanatorium, who made the post-mortem examinations and obtained the specimens.

DISEASES OF THE GALL BLADDER AND BILIARY TRACT

CLINICAL AND SURGICAL ASPECTS*

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THAT the gall bladder is not indispensable has been established by the excellent results obtained following cholecystectomy for disease confined to that organ. However, it is not to be assumed on this basis that the normal gall bladder is not indispensable to the best functional activity of the biliary apparatus. In general, the results of cholecystectomy have been best when existing disease confined to the gall bladder has disturbed most markedly the function of the gall bladder. In other words, there is minimum disturbance of biliary function following cholecystectomy for a functionless organ in the absence of extension of cholecystic disease to the biliary tract. Postoperative disturbance of a variable degree has at times persisted following cholecystectomy for definite cholecystitis with or without stones, when such disease has not previously interfered with the function of the gall bladder. Just why such biliary disturbance should be encountered postoperatively in the absence of extension of the primary cholecystic disease to the remainder of the biliary tract has not been adequately explained. Some years ago, Mann and Judd showed experimentally that following cholecystectomy, dilatation of the bile ducts and overthrow of the sphincter activity of the ampulla, with resultant loss of pressure in the bile flow, occurred, and that the flow of bile was more or less continuous into the intestinal tract, as in animals in which normally the gall bladder is absent. In some individuals it would appear that this constant flow of bile into the intestinal tract is not always tolerated. However, that constant flow of bile into the intestinal tract is usually well tolerated is shown by the absence of disturbance following the so-called sidetracking or shortcircuiting operations for permanent biliary obstruction, when an anastamosis is made between the gall bladder and the stomach or duodenum.

The gall bladder and biliary apparatus are so intimately associated with the liver and its functions, and the pancreas, that the results of operations on the gall bladder and biliary tract are often dependent upon the restoration of function of an impaired liver. This is particularly true when there has been associated common duct disease or obstruction and jaundice.

Disturbance of function of the liver secondary to gall-bladder disease is usually the result of infection or bile retention, or both. The peculiar markings of the surface of the liver so frequently observed in that organ directly adjacent to the gall bladder, to which area it is often grossly confined, have given rise to much speculation as regards its relation, if any, to cholecystic disease. The term "localized hepatitis" has been applied to such findings, and the condition has become of considerable significance to surgeons in determining whether or not disease really exists in the gall bladder in the absence of the otherwise easily recognized gross manifestations of cholecystic disease. A variable degree of localized hepatitis is found in many cases of cholecystic disease, and while the extensiveness of such hepatitis is indicative of the degree of cholecystic disease, considerable thickening of the capsule of the liver, with subcapsular deposit of fibrous tissue, has at times been observed when little if any cholecystic disease existed, as shown by careful examination of the gall bladder after its removal. In extensive cholecystic disease

* Read before the Los Angeles Surgical Society, October 10, 1930.

of long standing, localized hepatitis often has advanced to the degree of considerable scarring, thickening and deformity of the liver edge. Mentzer has shown that this change, while most marked about the gall bladder, occurs diffusely throughout the organ. It is only with secondary involvement of the biliary tract attending obstruction, with or without infection, that liver function may be seriously impaired.

Judd has very accurately described the difference in the changes which occur within the liver subsequent to obstruction without infection, those that occur in the presence of infection without obstruction, and those that occur subsequent to obstruction with infection. The best example of the changes which occur in the liver as the result of obstruction without infection is the condition produced in carcinoma of the head of the pancreas, involving or occluding the common bile duct. Corrosion specimens of the liver, as prepared by the method of Counseller and McIndoe, show enormous dilatation of the ducts, with clubbing of their ends. So far as the liver tissue is concerned, a true biliary cirrhosis occurs.

In the presence of infection without obstruction, as seen in cholangitis with or without common duct stones, the changes in the liver tissue are not nearly so marked as in those cases of obstruction with or without infection. So far as the biliary tract is concerned, even though great dilatation of the common duct is observed in some instances of infection associated with common duct obstruction by stone, the corrosion specimens rarely show extreme dilatation of the ducts within the liver. This has been explained by the incompleteness of the obstruction by stones, with intermittent periods of bile flow into the intestinal tract.

Mann and his co-workers, in their investigative work on the physiology of the liver and its functions, have contributed information of practical clinical significance with reference to liver damage resulting from cholecystic disease. Mann has shown that subsequent to the removal of the liver in the experimental animal there is a marked decrease in the blood sugar and cessation of urea formation, with an accumulation in the tissues of a yellow pigment which gives a positive reaction for bilirubin, indicating that the liver has to do with the formation of urea; that it is a storehouse for carbohydrates; that it maintains a fairly constant blood sugar level, and that it excretes bile pigment. Furthermore, Mann and his co-workers have shown that when cirrhosis of the liver has been produced in the experimental animal by the injection of carbon tetrachloride, a diet consisting largely of protein is fatal within a few days, while life may be prolonged indefinitely on a high carbohydrate diet. These observations have proved of great value in their clinical application to patients in whom extensive liver damage has occurred incident to cholecystic disease with involvement of the biliary tract. The preoperative and postoperative restriction of proteins and the use of a high carbohydrate diet have become most important in the treatment of patients with cholecystitis and disease of the biliary tract, amenable to surgery, and impaired liver function. It is immediately manifest that appreciable disturbances in liver function exert a profound influence on the general and total metabolism of the body, and inasmuch as cholecystic disease is an exceedingly frequent cause, with its subsequent biliary complications of hepatic insufficiency, cholecystitis may hardly be considered as a local disease, confined in its effects to the gall bladder and adjacent structures.

Clinicians, surgeons and pathologists have long speculated on the etiology of cholecystitis, and much investigative work has resulted in establishing a number of etiologic factors without definitely determining the exact cause. Unquestionably infection plays a most important rôle in the etiology of cholecystitis. However,

cultural studies of the gall-bladder wall, bile, and stones have failed to give a high incidence of positive cultures. Churchman, after extensive investigation of the infection theory, concluded that the pathologic condition in many cases must be due to changes in the blood vessels and causes other than those of bacterial invasion. Mentzer suggested that the lipoid deposits in the gall bladder, as seen in cholesterosis, or the so-called "strawberry cholecystitis," are evidence of the part the gall bladder plays in the metabolism of fat. Whether or not infection is a primary etiological factor, it becomes of utmost importance with the progressive changes that occur coincidental to cholecystitis and biliary tract disease.

The clinical manifestations of gall-bladder disease, when clinical symptoms are exhibited, are fairly definite and quite universally appreciated. However, extensive cholecystic disease at times develops as a more or less silent process so far as subjective data are concerned, and at times a most indefinite history only can be obtained. The silent pathological gall bladder and those in which indefinite symptoms are exhibited have been most elusive diagnostically until the advent of the Graham-Cole methods of cholecystography. Unquestionably, cholecystography has contributed most brilliantly to the diagnosis of gall-bladder disease, not necessarily as a method of depicting the absence or presence of pathology in the gall bladder, but in ascertaining function of the structure. Cholecystography is primarily a test of the dye-concentrating ability of the gall bladder, and, excepting in cases of stone, not a means of demonstrating pathologic changes directly. Unless disease of the gall bladder interferes with its function, cholecystography, except when depicting stones, may fail entirely in establishing a diagnosis of pathology. Definite disease does not always diminish the capacity for concentration of the dye, nor, as shown by Kirklin, Caylor, and Bollman, is the relation constant between the degree of concentration of bile and that of cholecystographic mediums. Cholecystography possesses its maximum value when the roentgenologist's interpretations, in terms of function, are appraised in relation to the history and other clinical factors. Kirklin has recently reported the general accuracy of 90 per cent of all cholecystographic diagnoses at the Mayo Clinic. The greatest error occurred in that group of cases in which the roentgenologist reported a normally functioning gall bladder without stones at operation. Cholecystography was found to be in error in 18.5 per cent of the cases. It is of interest that in the group of cases in which gallstones were found at operation, they were manifest as dense or translucent areas and diagnosed as gallstones in but 40 per cent of the cases, which is a higher incidence of the roentgen evidence of stones than could be relied upon prior to the modern methods of cholecystography. A negative and positive value may be placed on cholecystography when considered in conjunction with the history and other clinical data. A positive interpretation of poor or non-function with or without stones bolsters very materially a poor history. A positive interpretation in conjunction with a good history is simply corroborative, while a negative interpretation, with normal function shown by cholecystography, provides strongly supportive evidence of the absence of cholecystic disease with a poor or indefinite history. While the function of the gall bladder is more or less undetermined, it is too important a structure to be sacrificed needlessly, and a poorly functioning gall bladder without stones, as determined by cholecystography, in the absence of a history suggestive of cholecystitis, is insufficient evidence to condemn the gall bladder surgically.

So far as clinical manifestations of cholecystitis are concerned, I wish to discuss very briefly the clinical significance of jaundice. Little question exists regarding its significance in the truly obstructive lesions whether by stone stricture or

malignant disease. Formerly the diagnosis of cholecystitis was arrived at rather reluctantly unless a history of jaundice could be elicited. Experience has shown that cholecystic disease confined to the gall bladder is seldom accompanied by any degree of jaundice except in the acute process, with stones obstructing the cystic duct or neck of the gall bladder, resulting in cystic distention or empyema with pericystic inflammatory reaction and glandular enlargement, producing variable degrees of extrinsic pressure upon the common duct. However, the presence of jaundice or an antecedent history of jaundice immediately directs attention to the common duct, and extrinsic obstruction cannot be assumed until intrinsic obstruction has been excluded at operation. The advisability of exploration or careful examination of the common duct for intrinsic obstruction is apparent in all cases in which jaundice is present or has existed. Likewise, it should not be assumed because jaundice has never existed that stones or infection are not present in the common and hepatic ducts. It has previously been stated that following cholecystectomy in the experimental animal there is dilatation of the ducts, with loss of sphincter control at the ampulla. Unquestionally, in many humans some dilatation of the ducts occurs, but frequently I have observed in secondary operations subsequent to cholecystectomy very little if any demonstrable dilatation of the common duct. Also, in many instances, when the gall bladder is contracted down on stones and cholecystographic examination shows that no bile enters the gall bladder, and so far as function is concerned there has been a pathologic cholecystectomy, very little if any dilatation of the common duct is found in the absence of common duct stones. The point that I wish to make and emphasize is that in operations for cholecystic disease when undue dilatation of the common duct exists, even though there has not been a history of jaundice and no stones can be felt in the common duct, such undue dilatation, except in the presence of contraindication, indicates the advisability of incising the common duct and exploring for common duct stones. I have many times removed stones from the common duct when they had previously not been suspected. It is true that at times such exploration is accompanied by negative findings. However, experience has shown that under just such circumstances exploratory choledochotomy is productive of single or multiple migratory stones in the common hepatic ducts in more than 50 per cent of the cases.

I have recently reviewed the surgical findings and the operative procedures in 499 cases of cholecystic disease on my service at the Mayo Clinic during the last four years from July 1, 1926 to June 1, 1930, including the cases on which some surgical procedure on the gall bladder was required, and excluding all cases of secondary operations on the ducts for stone, stricture, malignant obstruction and so forth. Common duct stones were associated with cholecystic disease in 32 cases, or 6.5 per cent. In 27 additional cases, undue dilatation of the common duct led to exploratory choledochotomy unproductive of stones, an incidence of nearly 12 per cent necessity and advisability of exploring the common duct. It is furthermore worthy of note that in 4 cases of cholecystitis without stones, common duct stones were present. In but 1 of these had there been a previous operation upon the gall bladder, and that a cholecystostomy. In other words, one or more common duct stones were present in 3 cases in the absence of stones in the gall bladder.

Judd and McIndoe have recently suggested a classification of cholecystic disease, differentiating only between, first, acute, and, second, chronic cholecystitis, with subheadings under the latter of (a) chronic infective bacterial cholecystic disease, (b) cholesterosis, and (c) clinical or functional cholecystic disease. Except for the latter clinical subdivision the classification is on

the basis of existing pathology within the gall bladder irrespective of the absence or presence of gallstones.

From a clinical viewpoint, in terms of indications for operation, I am of the opinion that the question of stones is extremely important. Without doubt, there are many instances of cholecystitis without stones that are as urgently surgical as those cases in which stones are associated, and in many cases the symptoms are characterized by true seizures simulating gallstone colic, with failure to find stones at operation. In other cases without stones, the grade of cholecystitis is often as great as in those cases with associated stones. However, I am reminded (Table 1) that the gall bladder in 25 per cent of the cases of cholecystitis without stones upon which I have operated during the past four years failed to show any evidence of pathology when removed, even though hepatitis of a variable degree existed in many, and in all there was sufficient clinical evidence of cholecystic disease to justify exploration and cholecystectomy. Many of these patients have had complete relief of all symptoms following cholecystectomy, but unfortunately this has not been true of all.

Through the mechanical presence of stones, a different pathology exists from what is usually encountered in cholecystitis without stones. In Table 1 it is noted that there was an acute or subacute cholecystitis in 40 per cent of the cases with stones, while an acute cholecystitis without stones is rarely encountered except as part of generalized sepsis.

The so-called "strawberry gall bladder," or cholesterosis, is a most gratifying finding on exploration of the gall bladder, for the results following cholecystectomy, even though no stones are associated, approach very closely those obtained in the cases of cholesterosis in which stones are present. Cholesterosis was present in 22 per cent (Table 1) of the cases of cholecystitis without stones. Its incidence was not particularly noted in the cases of cholecystitis with stones. Mentzer reported an incidence of stones in about 50 per cent of the cases of cholesterosis. Sanders recently reported a 10 per cent incidence of cholesterosis in 500 cholecystectomies.

Table 1
CHOLECYSTIC DISEASE—499 CASES

Condition	Number	Number	Per Cent
Cholecystitis without stones	119	...	23.8
Cholecystitis 1-1	...	30	25.1
Cholecystitis 1	...	34	28.5
Cholecystitis 2	...	7	5.8
Cholecystitis 4	...	9	7.5
Papilloma	...	12	10.0
Cholesterosis	...	27	22.5
Cholecystitis with stones	380	...	76.2
Chronic chloecystitis	...	227	59.7
Subacute cholecystitis	...	119	31.3
Acute cholecystitis	...	34	9.0

Table II
OPERATION IN 499 CASES OF GALL-BLADDER DISEASE

	Number	Number	Mortality	Per Cent
Cholecystitis without stones	119	...	2	1.6
Cholecystectomy	...	54	1	
Cholecystectomy and appendectomy	...	56	1	
Cholecystectomy and choledochostomy	...	4		
Cholecystectomy and exploratory choledochotomy	...	5		
Cholecystitis with stones	380	...	10	2.6
Cholecystectomy	...	176	2	1.1
Cholecystostomy	...	11	3	27.0
Cholecystectomy and appendectomy	...	143	3	2.1
Cholecystectomy and choledochostomy	...	27	2	7.4
Cholecystectomy and exploratory choledochotomy	...	22		
Cholecystostomy and choledochotomy	...	1		

So far as surgical procedures are concerned in the treatment of cholecystitis, there frequently are associated lesions not only in the biliary tract but chiefly in the appendix and stomach or duodenum. The appendix is often as urgently surgical as the gall bladder. However, experience

has shown that if more than one of the associated lesions, as the appendix or lesion of the stomach and duodenum, is taken care of simultaneously with the gall bladder and biliary tract, the risk of the multiple procedures rises abruptly. The cases of acute cholecystitis, which for one reason or another must be operated upon during the acute stage, carry with them the greatest risk, particularly if cholecystectomy is undertaken. The question of cholecystectomy versus cholecystostomy in general is one no longer worthy of controversy, except in cases of acute cholecystitis and those with associated common duct disease and obstructive jaundice of long duration. The question of drainage following cholecystectomy is an individual problem. Personally, I prefer the insertion of a drain in most cases. Infection is certainly a factor in mortality following operations on the gall bladder and biliary tract (Table III).

Finally, as regards the selection of cases for surgical exploration, it may be stated that the history is of primary importance, that cholecystography is a most important adjunct to clinical findings, and that surgical results are best when surgery is confined to those cases in which cholecystitis can be diagnosed with a good bit of clinical certainty and little speculation. Under these circumstances, exploration will yield a high percentage of definite gross cholecystitis with stones, in which the surgical results are most gratifying.

TABLE III
CAUSES OF DEATH FOLLOWING OPERATIONS ON GALL BLADDER AND BILIARY TRACT

Case	Sex	Age	Condition	Operation	Days Post-operative	Clinical Cause	Findings
1	F	25	Cholecystitis 1-1 without stones	Cholecystectomy	10	Peritonitis ileus	Peritonitis
2	F	58	Chr. cholecystitis without stones	Cholecystectomy Appendectomy	10	Peritonitis	Peritonitis
3	F	60	Acute cholecystitis with stones	Cholecystectomy	3	Myocarditis	No exam.
4	M	62	Acute cholecystitis with stones	Cholecystectomy	6	Peritonitis	Peritonitis
5	M	61	Acute cholecystitis with stones	Cholecystostomy	3	Pneumonia	Acute pancreatitis Fat necrosis
6	M	33	Acute cholecystitis with stones	Cholecystostomy	3	Pneumonia	Hemorrhagic bronchopneumonia
7	F	41	Duod. ulcer Chol. with stones Subacute app.	Gastroenterostomy Cholecystectomy Appendectomy	5	Pneumonia	Aspiration pneumonia
8	F	51	Chr. cholecystitis with stones	Cholecystectomy Appendectomy	17	Pulmonary embolism	Pulmonary embolism
9	F	60	Chr. chol. stones Com. duct stones Chol. duod. fist.	Cholecystectomy Choledochostomy Close duod. fist.	15	Duodenal fistula	Duodenal fistula fat necrosis
10	M	36	Chr. cholecystitis with stones	Cholecystectomy Appendectomy	30	Phlebitis and thrombosis	Phlebitis of rt. Fem. & il. veins Gangrene rt. foot and leg
11	M	43	Subacute chol. with stones	Cholecystectomy Choledochotomy	12	Cholangitis	Cholangitis
12	F	56	Subacute chol. with stones Diabetis	Cholecystostomy	27	Pneumonia Diabetis	Embolic pneumonia nephritis

NEW INSTRUMENTS FOR LIVING SUTURES

TO FACILITATE THE USE OF LIVING TISSUES AND TO REDUCE SUTURE TRAUMA*

CHAS. MURRAY GRATZ, M.D.

NEW YORK

As early as 1901 transplantation of living fibrous tissue for the repair of anatomical defects was used in experimental and clinical surgery. The early method, using patch transplants, was not universally satisfactory. The viability of the transplant depends on the formation of fibrous connective tissue between the transplanted and the host tissues. The lymphatic supply which nourishes the transplant is obtained through this newly formed tissue. When large transplants are used the nourishment to their central and more dependent portions often proves inadequate. Excessive mechanical stress also tends to displace this connective tissue, more particularly if the edges are inaccurately or insecurely attached.

Gallie and Le Mesurier[1] were the first to use living material in the form of a suture. The changed form of the transplant allowed a larger percentage of stress to be borne by the suture itself; it was no longer necessary to rely entirely on newly formed connective tissue. The realization of this advantage widened its field of usefulness.

Living sutures being of a soft and slippery nature are difficult to handle with ordinary surgical instruments. Since they are short and no autogeneous material should be sacrificed, it is poor technique to use the long overlap in threading that is permissible with ordinary suture material. Gallie improved the old type surgical needle by sufficiently enlarging the eye to accommodate it to the size of living sutures. The tendency of the needle to become unthreaded was prevented by overtying with catgut. Threading these needles even with the enlarged eye is often a difficult and tedious process. Suture trauma is increased by the tendency of the suture to bunch in the eye of the needle and also by the effect of the overtying suture.

Realizing that these factors hinder the wide use of living sutures, I endeavored to develop new instruments which would not only overcome these difficulties, but would be suitable for use in osseous as well as in fibrous tissues.

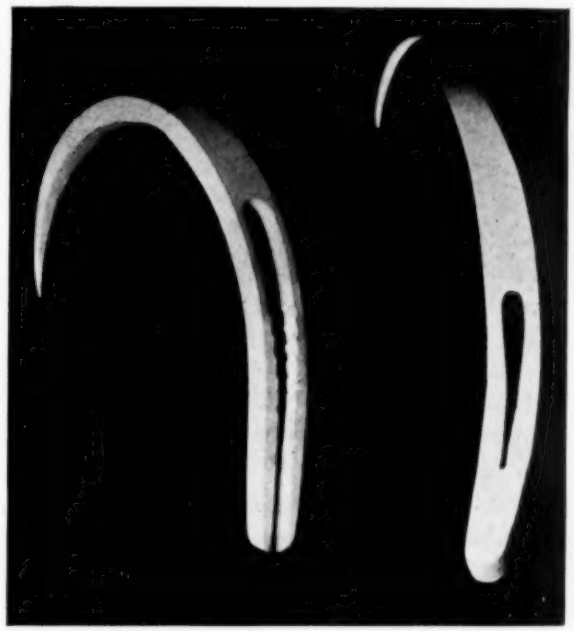

FIG. 1. New needle for living sutures.

A curved cutting edge needle of rectangular cross section was devised with a special eye. The details of the new needle are clearly illustrated in the illustration (Fig. 1). The needle is tapered posteriorly and curved on the outer posterior side. The eye is formed as an elongated wedge with the thin end toward the heel of the needle and is wider on the outer than the inner side. The posterior half of the eye is finished with sloping teeth while the anterior portion remains smooth. This type of eye permits the insertion of the living material edgewise at the larger anterior end. When tension is applied to the suture

[1] Gallie and Le Mesurier. The use of living suture in operative surgery. *The Canad. M. A. J.*, 11: 504, 1921.

* Presented at the Orthopedic Section, New York Academy of Medicine, May 15, 1931.

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it is drawn down to the thin end of the wedge. The sloping teeth tend to force the material farther and more securely into

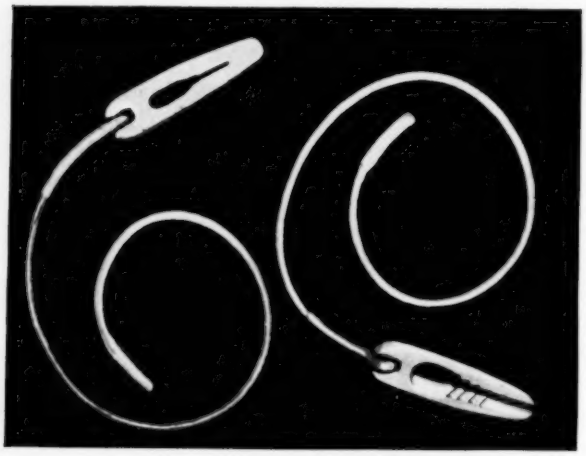

Fig. 2. New suture threader.

the eye. The specially designed eye permits the threading of the needle with a minimum of wasted suture, holds the suture with a maximum of firmness, and thus entirely eliminates the necessity of overtying. The absence of overtying reduces suture trauma, which is further minimized by the ease with which the suture may be threaded through the tissues. We were greatly pleased to find that the use of the finest materials and expert workmanship in making the new needle resulted in a much smaller instrument than the old type.

In using living sutures in bone surgery it has previously been necessary to tie the suture to a smaller one of catgut or silk which is in turn threaded through an ordinary needle. The fascial suture tends to fray as it is drawn through the bone and frequently pulls away from the guide suture. To facilitate the passage of the suture through bone Henderson placed cannulas through and beyond the drill holes to cover the rough edges of the bone. Bodkins have also been used. Many surgeons use large drill holes and push the suture through with a grooved director. All of these methods require larger drill holes with resultant weakening of the bone and an inaccurate apposition of the suture to its new environment. A second type of needle, really a suture threader, was devised to simplify and improve this technique. The details of the new suture threader are here illustrated (Fig. 2). This is essentially the eye of the needle previously described made straight and very short with a flexible wire leader securely attached to the toe end. The flexible wire may be easily pushed through the drill holes; its flexibility permits the surgeon to insert the suture even if the holes are irregular or imperfectly aligned. After it has passed through the bone, the end may be readily grasped with a pair of forceps and the suture placed in position with much less dissection than if a straight needle had been used. This suture threader may also be used for prepared sutures.

Comment: 1. The new needles are threaded to the suture while the main body of the latter is intact and they remain in place until the suture has been firmly anchored in position. These needles may be threaded with ease by using a specially prepared mosquito clamp. The jaws are ground down so they can go through the eye of the needle grasping the tapered end of the suture on the outer side and pulling it through.

2. The special features of both these needles: the small size, the tapered eye, the tapered heel, and the groove on the posterior surface, not only render overtying unnecessary but in conjunction with the taper on the end of the suture allow the united portion to be approximately the same diameter as the main portion of the suture. This places the entire suture in close contact with either the fibrous or osseous structures by which it is surrounded. It is also possible in bone work to thread two sutures through one hole simultaneously. The accurate contact between the suture and the tunnel in the bone permits an adequate lymphatic supply, thus enhancing the viability of the suture. This is of the utmost importance, as a suture much smaller in diameter than the hole through which it is inserted has less likelihood of securing the adequate lymphatic supply on which its viability depends.

VASCULAR DISEASES OF THE EXTREMITIES

V. RAYNAUD'S DISEASE*

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NEW ORLEANS, LA.

AUGUSTE MAURICE RAYNAUD, in 1862, at the age of thirty presented for his doctor's degree a thesis entitled "Local Asphyxia and Symmetrical Gangrene of the Extremities."

Although the disease which he so masterfully described had been observed by Schrader, in 1629, and Hertius, in 1685, the following excerpt from his monograph shows that it had remained for him to establish the causative factor of this symmetrical mortification.

I propose to show that there exists a variety of dry gangrene affecting the extremities which is impossible to explain upon the basis of vascular obliteration; a variety characterized especially by a remarkable tendency to symmetry since it always affects similar portions of the body, the two upper extremities, the two lower extremities, or all four at the same time. In certain instances the nose and ears are also affected. I shall seek to prove that this kind of gangrene has as its cause a disturbance of the innervation of the capillary blood vessels.

CLINICAL PICTURE

Clinical characteristics of a typical case are concisely described by Cassirer as follows:

Somewhere in the peripheral portions of the body there occurs more or less severe pain. This is not confined to distinct nerve territory, but usually affects symmetrical parts. Attacks of vasomotor and trophic disturbances are part of the syndrome, to wit: (1) syncope, asphyxia, or local rubor, and (2) severe trophic disturbances, usually in the form of gangrene of the parts first affected with symptoms. The course is an intermittent one, for there may be completely free intervals; but in some instances, evidences of disturbed vasomotility may persist. The disease may consume itself in one attack or several attacks may occur in succession. Objectively, sensory disturbances are usually absent, as well as paralysis, although other evidences of disturbed vasomotor innervation, aphasia, hemoglobinuria, and arthropathies may occur.

ETIOLOGY

A wide difference of opinion is found to exist among medical authors as to the predisposing and direct causes of Raynaud's disease. However, it is agreed that the symptomatology is dependent upon a vasomotor disturbance. Raynaud, Monro, Barker, Osler, Buerger, Barlow, and others have suggested a hereditary factor, but more recent studies seem to prove that Buchanan and Monahan are correct in definitely ruling out any inherited predisposition. The latter found a neurotic temperament to exist in only half the cases reviewed. Syphilis, malaria, typhoid fever, typhus fever, influenza, and other conditions which give rise to a toxemia have been thought to be etiologic factors, but now they are merely regarded as having occurred in association with the disease. Sexual excess and excitation were suggested as causes by Raynaud, but these, no doubt, should be listed as contributory factors, along with exposure, trauma, psychic exertion, sudden fright, and acute infections. That exposure to cold precipitates an attack can be demonstrated in the majority of cases. Monahan believes that in view of the sterility of the discharge from diseased tissues one must look for the fundamental cause in some constitutional abnormality or subnormality, which might produce a chemicophysiologic toxin.

INCIDENCE

Age. According to Raynaud, most of the cases occur between the ages of eighteen to thirty years. Monro gives the average

* Presented before the Surgical Faculty of Tulane University, New Orleans, March 17, 1930.

Previous articles on Vascular Diseases of the Extremities appeared as follows: I. Arteriosclerotic disease, vol. 12, p. 32; II. Erythromelalgia, vol. 12, p. 40; III. Thermic Gangrene, vol. 12, p. 324; IV, Thromboangiitis obliterans, vol. 12, p. 489.

age of onset as 28.9 years, and Morgan in his 93 cases found it to be 26.6 years. Cassirer collected 168 cases and found that there were 55 in which the disease occurred in the first and second decades of life as compared with 40 in the third decade. Subsequently, in studying 109 cases, he found the greatest age incidence from twenty-one to forty-years of age. Of 67 cases studied by Buchanan at the Mayo Clinic, 36 were in patients from twenty-one to forty years of age. That the disease may frequently occur in children is evidenced by the fact that Cassirer collected 22 cases occurring in patients less than five years of age. In the more recent literature there are numerous reports of its occurrence in infants and in the newly born. Not infrequently the disease is reported to have been observed in individuals of advanced years; but that these are cases of true Raynaud's disease is to be doubted except in those few in which the symptom-complex was characteristic. E. P. Henry reported a case in which the phenomena occurred in the ears, nose, and extremities in a woman seventy-seven years old.

Sex. Women are more frequently affected. Raynaud found that 80 per cent of his cases were in women; 6.2 per cent of Monro's cases were females, and this sex predominated in 62.9 per cent of Cassirer's series and in 59.8 per cent of Buchanan's series. Adson and Brown believe that with improvement in diagnosis the incidence of true Raynaud's disease in the male will drop to less than 5 per cent of cases.

The racial and geographical distribution has been shown to be fairly widespread. Three cases have been reported in the negro by Lee.

That Raynaud's disease is rare has been shown. Monro reports that it occurs about once to every 3000 other affections and Buchanan found that it comprised less than 0.02 per cent of registrations at the Mayo Clinic. At the Johns Hopkins Hospital there were 19 cases in 23,000 admissions.

Buchanan states that he could not demonstrate that physical or nervous strain incident to any one type of occupation or social stratum was a cause of the condition.

MODES OF ONSET AND DURATION

Sixty out of Buchanan's 67 patients described a sudden onset with portions of the body turning white, blue or black. Five described a gradual onset consisting of tingling, numbness, clumsiness, or indescribable discomfort occurring at irregular intervals, followed at a later date by the color phenomena.

Raynaud described the onset of the disease as sudden and the duration as short. Other early observers gave the same conception; but with a more widespread knowledge of its symptomatology and better methods of diagnosis the chronic and insidious forms of the disease have been recognized and not infrequently reported.

Monahan reports a case in which prodromal symptoms lasted for nine months before the acute stage occurred to persist for four years before amputation was resorted to.

Many of the mild cases require exposure to cold to produce the characteristic symptoms. These may clear up and remain symptom-free, especially if winters are spent in tropical zones. However, most cases remain remittently active, although some may never advance to the moderate or severe forms.

Buchanan reported that 30 of his cases had had symptoms for more than five years and of these 7 had been affected for from fifteen to thirty years and 1 for forty-three years. Thus, it is evident that the duration is not always short.

That the disease may spontaneously subside cannot be doubted. Proof of this cannot readily be obtained, as recovered cases are usually lost before a conclusive period of observation is ended. Certainly many mild cases remain undiagnosed or unobserved simply because they subside or do not progress to the extent that the classical picture is evident.

Even cases of moderate severity may progress slowly and subside after several attacks which have produced small areas of gangrene.

Osler states that the severe cases are exceptional, although every large hospital is likely to have one that returns at intervals for amputations until the victim finally drifts into an almshouse.

SYMPTOMATOLOGY

Three characteristic phenomena of the disease are generally described. These are: (a) local syncope; (b) local asphyxia; (c) local or symmetrical trophic lesions or gangrene.

The term "local syncope" was used by Raynaud to signify the blanching of a part. It is manifested in the fingers, toes, cheeks, ears or nose and less frequently in other parts by a sudden death-like, demarcated pallor and a decrease in surface temperature of from 15 to 20°. This condition lasts from a few minutes to a few hours and may rarely result in gangrene. It usually recurs with or without periodicity and is likely to be precipitated by exposure to cold. Associated with it is a feeling of numbness, tingling or coldness. The attack may be terminated by a painful reaction. In only 3 of Monro's 176 cases local syncope existed alone, and Buchanan noted it alone in 15 per cent of his cases. It occurred either concomitantly or associated with local asphyxia in 10 per cent of Monro's and in 42 per cent of Buchanan's cases.

Boyer originated the term "local asphyxia," but it was Raynaud who applied it to that phenomena of the disease which usually follows, but may rarely precede syncope. As the term implies, there is a local anoxemia which causes the skin to appear bluish white, dusky blue, slate color, dark blue, violet gray or purple, or there may be redness with mottling of degrees of blueness. Surface temperature is decreased less than it is in syncope, and there is often a temporary swelling of the part or a cold sweat may appear. If this phenomenon persists, the skin becomes black and mortified, or there may result desquamation of the epidermis. Occasionally an incomplete asphyxia may persist for years to produce a false edema as a result of undernutrition to the part. Local asphyxia is more prone to recurrences and is usually accompanied by more severe pain than is syncope. This phenomenon occurred alone in 16 per cent of Monro's cases and in 6 per cent of Buchanan's. When it occurs simultaneously with syncope, there is a play of colors with many shadings from cadaveric white to several tints of blue or bluish red, or the phalanges may be white while proximally there is a change to a bluish tint. Pressure over an affected part displaces the color which characteristically does not reappear for some time.

Following either syncope or asphyxia there may follow a period of hyperemia in which redness is marked and is accompanied by increased pulsations, increased warmth of the part, increased moisture, and a tingling sensation approaching that of pain.

With recurrence and persistence of the phenomena discussed gangrene of the peripheral parts eventually results. A bleb may form at the tip of the fingers and discharge a blackish or serosanguineous content. The resulting ulcer usually heals by cicatrization. Not infrequently a finger tip may merely become thickened and indurated and later desquamate. More commonly there occur sharply demarcated blackened, symmetrical areas which remain dry for variable periods of time before sloughing. These areas may be massive, causing the loss of a leg or forearm or even a whole extremity. Healing by granulation with the formation of a tapering cicatrix is characteristic. Although the gangrene is usually of the dry variety, it may at times be moist.

Pain in this disease is an important symptom as it almost constantly occurs though it may be absent in one attack and present in another. It may precede an

attack; but usually it coincides with asphyxia or syncope as a painful numbness followed by a sensation of burning and tingling. It is exaggerated by pressure or the occurrence of gangrene and may occasionally radiate to unaffected extremities.

Heat and cold sensations are not changed, but rarely is there analgesia or diminution in tactile sensation. In all phenomena the skin is likely to be covered with a clammy moisture.

Motor disturbances are not observed unless muscular atrophy occurs.

Bone changes were first observed by Cassirer. Characteristically, one or more or all the terminal phalanges may become atrophic or disappear without the formation of a sinus. Long bones may also become involved as manifested by a thinning of the cortex and an increase in the size of the marrow cavity in an occasional case.

Pulsations in the dorsalis pedis, posterior tibial, and radial arteries are commonly thought to be absent during the stage of syncope. This is incorrect as pulsations, though at times diminished, may be elicited in all stages of the disease.

Blood pressure determinations, pulse rates, and blood pictures were found to be within normal limits in all cases at the Mayo Clinic. Hemoglobinuria was not observed in any case, though it has been reported by many authors.

AREAS INVOLVED

Of the cases reported by Buchanan the lesions were bilateral and symmetrical in 56.7 per cent and asymmetrical in 43.3 per cent. Buerger states that symmetry is occasionally lacking and reports of isolated cases in the literature substantiate this. Not infrequently the nose, lips, and sternal regions are affected and very rarely multiple gangrenous areas occur anywhere on the trunk.

Monro found the upper extremities were affected in 43 per cent of cases, the lower extremities in 24 per cent, and both in 22 per cent. Buchanan found the lower extremities more frequently affected, but he reports quite a diverse distribution in some cases. Nineteen patients had lesions all over the body, one on the side of the tongue, one in the pharynx, one on the left side of the face and one in which both forearms and lips sloughed and healed by cicatrices.

That this disease has an even more widespread anatomical distribution is believed by many. Raynaud himself noticed that there were coincident alterations in the retinal vessels with impairment of vision in 2 of his cases when the characteristic phenomena occurred in the extremities. Many cases with like symptoms have been reported, the most recent being those of Shinkle and Appelbaum. Weiss reported a remarkable case in which the left cervical sympathetic nerve was involved causing the left chest suddenly to become warm and red, the left eyeball to retract, hyperhidrosis, and contraction of the pupil. A recession of all manifestations except for slight retraction of the eyeball was complete within a week, but recurrences occurred until finally a condition similar to a partial atrophy of the soft parts of the left side of the face remained.

Hemoglobinuria in association with Raynaud's disease was not observed by Raynaud. Hutchinson in 1871 recorded the first case in which this symptom occurred and subsequently similar cases were recorded by Druitt, Wilks, Southey, Barlow, Dickinson, Abercrombie, Monro, Spencer, and many others.

Scleroderma and sclerodactylia not infrequently occur in association with the typical phenomena of Raynaud's disease and have been thought by some to be merely a complication of Raynaud's disease. Certainly at times when either is present, it is impossible to rule out Raynaud's disease.

Raynaud referred to fibrous ankylosis of the terminal phalangeal articulations and to thickening along the processes of the palmar fascia and showed how remarkably such thickening may subside following recovery from prolonged local asphyxia.

Southey reported a case in which there was an effusion in both knee joints.

Osler states that in a large number of mental disorders attacks of Raynaud's disease have been observed. Mania, epilepsy, amentia, melancholia, circular insanity, and progressive paralysis of the insane have been reported to occur in association with the disease.

Not a few cases exhibiting the characteristic phenomena have developed transient monoplegias, hemiplegias, aphasias, and even paraplegias. It seems reasonable to regard these attacks as due to vascular changes in the brain of the same character as those which occur in the peripheral vessels.

PATHOLOGY

The most frequent lesion observed in Raynaud's disease is the gangrene which is usually of the dry variety. It is sharply demarcated and remains so until the slough comes away. Infection rarely occurs and healing readily takes place by granulation. When a peripheral part is involved, there results a characteristic tapering cicatrix.

Bleb formations with resulting ulcerations may be observed or there may occur dry dystrophic processes in which a dark scab forms and subsequently becomes detached in a scale-like manner.

That the characteristic lesions are due either to constriction of the capillaries or to dilatation and stasis in them has long been assumed, but it was not until 1925 that Brown and others made observations with the capillary microscope which satisfied all doubts concerning the type of lesions.

Brown concluded from a study of 8 cases under various conditions and in different stages of the disease that in local syncope there is a constriction of all three vascular elements in the skin and that in local asphyxia there is a refilling of dilating capillary loops from segments of arterial or venous blood or both. In this latter stage there is apparently a loss of coordination between the capillaries and arterioles. The arteries still remain contracted, except for an intermittent relaxation which allows small segments of arterial blood to enter the dilated capillary loops. The venules apparently undergo similar reactions since a reflux of blood takes place into the capillaries Dilatation of the capillaries precedes the cyanosis, and it is this change in caliber together with a loss of tone which causes stasis and a resulting increase in carbon dioxide content of the blood.

PROGNOSIS

Prognosis as to life of an affected part has been poor in the past and amputations have been frequently performed in order to alleviate pain. It seems reasonable to assume that for the most part only the more advanced or severe cases were observed, and consequently the older writers have given a gloomy outlook for patients affected with Raynaud's disease. With an increasing number of early cases being recognized and observed for years and with the advent of more satisfactory therapy, we are finding that an affected part may remain useful for many years in not a few cases.

DIAGNOSIS

The diagnosis of Raynaud's disease is made on the finding of a combination of the characteristic phenomena. The mere observance of ischmeic fingers hardly warrants a diagnosis; but the absence of single symptoms in a case which has been adequately studied and observed for a sufficiently long period should only rarely render the diagnosis uncertain.

Differentiation of Raynaud's disease from other vasomotor and trophic neuroses is occasionally difficult and may be impossible without prolonged observation.

Certain cases of scleroderma, especially those exhibiting sclerodactylia, manifest vasomotor symptoms and are believed by some to be caused by lesions of the sympathetic nervous system. Numerous cases are on record in which Raynaud's phenomena occurred coincidentally with,

preceded, or followed the development of the indurative and atrophic stages of scleroderma and sclerodactylia. Since in Raynaud's disease there may not infrequently develop induration and thickening of the skin and subcutaneous tissues, a differentiation from scleroderma may be impossible until the skin lesion spreads to other areas in which manifestations of a vasomotor disturbance are not evident. The absence of pain and paresthesia is of value in eliminating Raynaud's disease; but when pain and paresthesia are present, one should consider that the two diseases coexist until further observation proves otherwise.

Erythromelalgia should offer no difficulty in differential diagnosis. The attacks are precipitated by heat or dependency of the affected part. The redness, increased temperature, and pain disappear on elevation of the part and are alleviated by the application of cold, whereas in Raynaud's disease the attacks are likely to be initiated by exposure to cold, are not infrequently relieved by application of heat, and elevation of the part does not result in a lessening of the asphyxia.

The acroparesthesia of Schultze or Nothnagel resembles Raynaud's disease in that suddenly or gradually the fingers or even the hands and arms become cold, numb, white, and painful. Disturbances of tactile sense and a diminished sensibility for needle pricks, touch, temperature, and electrical irritants exist. Both hands are affected, though usually unequally. The differentiation from an early stage of Raynaud's disease is impossible unless Raynaud's second phenomenon of asphyxia occurs.

Acroasphyxia chronica manifests itself as a slowly developing cyanosis of the peripheral parts without paroxysms or attacks associated with sensory or trophic disturbances. In certain cases a hypertrophy of the soft parts develops, which resembles acromegaly. Although this condition differs from Raynaud's disease in its progressive course, absence of paroxysmal attacks and development of hypertrophied peripheral parts, there are cases which seem to be clinical transitions to Raynaud's complex. Even in these, however, syncope does not occur and pain is insignificant.

The differentiation of Raynaud's disease from obliterative vascular disease is usually easy. In arteriosclerosis of the extremities the calcified vessels are palpable as cords and are found not to pulsate, whereas in Raynaud's disease pulsations are obtainable at all times. The paroxysmal nature of the attacks, the youthfulness of the patient, the absence of pain of intermittent claudication, and the more frequent involvement of the upper extremities are important differential points for Raynaud's disease.

Thromboangiitis obliterans with vasomotor symptoms is at times difficult to differentiate, especially since Buerger warned that in Raynaud's disease ischemia and rubor may be elicited. These, however, may be observed only during the paroxysms in Raynaud's disease, whereas they may be elicited at will in thromboangiitis obliterans. If this point is borne in mind, no difficulty should be encountered in arriving at a diagnosis. In certain cases of Buerger's disease the inexperienced may be misled by finding that the dorsalis pedis pulsation is still present. In these the thrombosis has not extended beyond the digits, and the rubor and ischemia are found to be more or less limited to the area of vascular obliteration. If other characteristic symptoms of thromboangiitis obliterans, such as pain of claudication, trophic lesions, and migrating phlebitis are not present, one may have to depend on the sex of the patient and the localization of the disease for differentiation.

TREATMENT

Therapy in Raynaud's disease aims only at a symptomatic cure. Mild cases which are more common probably do best without any treatment other than the institution of prophylactic measures. The wearing of warm loose gloves, soft woolen stockings,

and adequate clothing usually suffice to minimize the frequency of attacks. Removal to warm, even climates has proved beneficial in not a few cases. Attacks may be aborted or shortened by the application of heat. If these cases do not progress in two years, they probably never will; but should they become more severe, more energetic measures are indicated.

Repeated galvanic hand and foot baths of ten minutes' duration have seemed to help some few; but results equally as satisfactory may be expected from the production of hyperemia by Bier's method or by the use of an elaborate apparatus designed to produce a negative pressure about the affected part. Cushing advocated the application of a semi-elastic bandage just tight enough to constrict the venous return from the part. This may prove beneficial, but pain is intensified.

Amyl nitrite and nitroglycerin have quite naturally been given a trial by many, but there are no reports of either's ever having been of constant benefit.

Various endocrine gland extracts have been vaunted as of exceptional value, but like all other conservative measures they have fallen into disuse in uncomplicated Raynaud's disease.

Recently Brown and Adson have reported distinct benefit in some few cases from the production of a febrile reaction by the injection of non-specific proteins. A vasomotor paresis is thought to result from fever.

Certainly conservative treatment as outlined has only occasionally proved satisfactory. Those cases not destined to remain mild have progressed in spite of treatment and, because of this, more radical measures were sought, and these are now fast becoming standardized.

Small areas of gangrene should be allowed to demarcate and slough, as healing by cicatrix may be expected. Large gangrenous areas are best amputated to save time and free the patient of pain.

With the development of surgical procedures designed to interrupt innervation of the affected vessels, it became customary to refer to the surgeon all cases which showed trophic changes or gangrene. The results in these were at first inconstant, but encouraging enough to warrant further investigation. Various modifications were instituted clinically and experimentally, and out of fifteen or more years of untiring effort have come certain standardized surgical procedures on the sympathetic nervous system which promise such an excellent symptomatic cure that all but the mild unprogressive cases should be given the benefit of this newly developed therapy.

The evolution of surgery of the sympathetic system is an interesting chapter, too lengthy for a detailed review in this paper. In 1913 Leriche performed his first periarterial sympathectomy believing that he was dividing the motor nerves of the vessels. The result was gratifying and in subsequent procedures on well selected cases the symptomatic relief warranted his removing the adventitia from vessels in over 300 cases manifesting symptoms of various vasomotor disturbances. Other workers, because of faulty technique and improper selection of cases, did not obtain comparable results and the procedure became the subject of criticism. Leriche observed that his procedure produced bilateral vasodilatation and eventually concluded that he was not interrupting vasomotor fibers, but that he was altering vasomotor activity by dividing pressor or centripetal fibers. He reasoned that division of these fibers around one vessel stimulates "long distance" reflexes which result in a transitory modification of blood pressure and blood flow in all four extremities and that local hyperemia is of a more persistent nature because pressor influences are freed from distal intramural centers, which probably exist even though they have not been demonstrated anatomically. Regardless of how a periarterial sympathectomy produces its characteristic effects, it is probably worthy of trial in those who are poor risks for a ganglionectomy, because it is easy to execute and because there is

clinical evidence to indicate that a symptomatic cure may occasionally be expected. The hyperemia obtained by this procedure may last for only one or two weeks, but the symptomatic relief not infrequently persists. Leriche in 1928 stated that periarterial sympathectomy produces less marked and less persistent local hyperemia than does sympathectomy upon the trunk. This latter procedure apparently has not produced the unfavorable complications that were predicted for it, and therefore its use in even moderately severe cases is justified.

Adson and Brown, quick to recognize the incompleteness of effects from the Leriche operation, sought more satisfactory results from operations on the sympathetic trunk. In 1924, Royle, after sympathetic ramisectomy for spastic paralysis, observed a capillary dilatation of the leg on the operated side. Soon after this, Adson and Brown began using a modification of this procedure for Raynaud's disease and found that pain was relieved, abnormal color reactions disappeared, the feet and legs presented a pinkish color, were drier and sustained an average increase in temperature of 12°C. They believe that the distribution of the gray rami from the lumbar ganglia is not constant, and, therefore, instead of doing a simple ramisectomy as urged by Leriche, they resect the second, third, and fourth lumbar ganglia with the intervening trunk bilaterally, thus making sure that interruption of all efferent impulses below the second lumbar ganglion is complete. Patients so operated upon have remained symptomatically cured for as long as five years and promise to remain so permanently. Davis and Kanavel performed a similar ganglionectomy on one side in a case of erythromelalgia and obtained definite improvement. Thus, for the lower extremities one has a procedure which gives complete and satisfactory results.

But Raynaud's disease more frequently attacks the upper extremities and cervical sympathectomies as done by Adson and Brown, Fulton, Diez, Royle, and Davis and Kanavel have given only incomplete results. These workers excised the stellate ganglion in all cases and in some all of the cervical ganglia were removed. Davis and Kanavel, after observing their result, concluded that removal of the stellate ganglion alone would suffice. Recognizing that results obtained in the upper extremities were not as satisfactory as those observed in the lower extremities, Adson and Brown concluded that all efferent vasoconstrictor impulses to the vessels of the upper extremity were not being interrupted. This was verified in 1927 by Kuntz, who showed that the second thoracic ganglion contributes gray fibers to the first thoracic spinal nerve, as well as to the second thoracic spinal nerve, and this, in turn, often contributes to the lower trunk of the brachial plexus. Subsequently, Adson and Brown through a posterior approach succeeded in excising the second thoracic ganglion along with the stellate ganglion and the intervening trunk on the right side of a patient with Raynaud's disease. Following this the right hand became warm and dryness of the skin was noted over the entire right arm, axilla, right side of the face, and the right anterior surface of the chest down to the sixth interspace and posteriorly down to the fifth dorsal vertebra. An incomplete Horner's syndrome was present, but it later almost entirely disappeared. At a later date the left side was operated upon with similar success, except that the Horner's syndrome on this side remained. Subsequently other patients subjected to the same procedure were similarly benefited.

Adson now advocates resection of the last cervical together with the first and second dorsal ganglia. This change was instituted, because the other procedure did not completely interrupt sympathetic fibers as evidenced by the incompleteness of the Horner's syndrome obtained.

It seems reasonable to expect multiple symptomatic cures in patients manifesting Raynaud's phenomena in all four extremities if these complete procedures are properly executed.

[*For References see p.* 128.]

PARTIAL RESECTION FOR UNILATERAL REDUPLICATION OF PELVIS AND URETER*

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NEW YORK

IN a recent article published in the *Journal of the American Medical Association* upon conservative surgery on the kidney, Waltman Walters drew attention to the fact that 3 patients having heminephrectomy for reduplication of the ureters were successfully operated upon by William Mayo and reported by Braasch in 1912. Young and Davis in 1917 have been quoted as saying that these 3 cases were probably the first successful ones in the United States. At that time they were able to find in the literature only 26 cases in which heminephrectomy had been done for duplication of the renal pelvis, and added 1 of their own bringing the total to 27.

However, resections for various reasons were done much earlier than this. To Pawlik is given credit for first attempting partial nephrectomy in double kidneys in 1896; yet Czerny as early as 1887 reported a case of resection for tumor of the lower pole. Tuffer in 1891 operated upon a patient for a localized cyst, and Keetly resected part of a traumatized kidney.

At the close of the 19th century conservatism was quite popular but short-lived. For, Kuster in reviewing the literature of the earlier days, found 30 cases of partial resection, out of which 18 patients improved, 7 did not, and 5 died. Apparently the results following partial resection did not find favor with the surgeons of that day, as very little further is to be found in the literature concerning the subject.

The mortality in these early cases was 16 per cent, but as Judd pointed out this was comparatively low in the early period of renal surgery, considering that nephrectomies were being then performed with a mortality of from 25 per cent to 35 per cent.

With the introduction of the 20th century conservatism was again overshadowed by radical nephrectomies, but only again to be replaced in the last ten years of this century by what may be summed up in the words of Hinman, who says, "Conservation of renal tissue is the objective of modern renal surgery."

Judd in 1925 reported a series of 8 operations performed for various reasons, 2 of which were for reduplication of the pelvis. This was followed by a report in the same year by William Honan for calculous pyonephrosis. From then on we find the literature much richer in this type of work with case reports by such men as Young, Quinby, Eisendrath and Phifer, Papin, Beer, Hymen, Keyes Furniss, Von Lichtenberg, McCarthy, Lazarus, Bugbee, Hunt, Walters, Rathbun, Lower and Belcher, De Vries, and Campbell who reported a series of 5 cases before the Genito-Urinary Section in the New York Academy of Medicine two years ago.

However, in spite of all this work, only 222 cases of partial nephrectomies performed for all causes, including cysts, localized tumors, trauma, tuberculosis, horseshoe kidneys, ecchinococcus cysts, reduplications and associated calculous pyonephrosis, have been reported up to 1928.

The case we present is of that of a young man forty-two years of age, first seen by me last July in a severe attack of pain in the left kidney region, associated with scanty urination and simulated to all extent and purposes a typical renal colic. A urinalysis at the time showed only an occasional red blood cell and pus cell. With the exception of a typical Murphy sign over the left lumbar region, a physical examination as well as a plain *x*-ray

* From The Urological Service, Flower Hospital, N. Y. C. Read before the Section of Genito-Urinary Surgery, New York Academy of Medicine, December 17, 1930.

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of the genitourinary tract was normal. His previous history is one of interest and dates back seven years, when he first experienced a severe excruciating pain in the left kidney region, localized through this area but persistent in nature and increasing in severity. He was then removed to Bellevue Hospital where he remained for three weeks feeling much improved upon being discharged. Since then these attacks have been growing more frequent, so that he would lose a great amount of time from his work and was thought to be a malingerer.

Cystoscopic examination at this time did not reveal any pathology, and had it not been for a pyeloureterogram a diagnosis of this condition could readily have been overlooked. The split urines from the right and left kidneys were quite negative with the exception of a few red blood cells and pus cells from the left side. Both kidneys functioned well and the return of the intravenous indigo dye was five minutes from both kidneys and in very good concentration. Cultures and smears were negative for organisms. The urea content was normal from both sides.

Pyeloureterogram showed a definite reduplication of the pelves and ureters, which met just above the bladder and entered this organ as one ureter. It seemed as if the ureter from the upper segment was crossing the lower ureter at its pelvouretero junction, and in this manner causing temporary attacks of hydronephrosis.

Considering all the facts of this case, the predominant factors for surgical intervention were first pain, excruciating in character, more severe with each attack, seven years in duration, which now had become quite frequent. Second, beginning hydronephrosis of the lower segment, and third, the economic factor in loss of time, for work was now becoming almost impossible.

Reduplication per se has been estimated to have an incidence from post-mortem examinations anywhere from 3 to 4 per cent, and most cases are of themselves only of academic interest, found during the routine urological examination and now more than ever with the advent of intravenous urography.

Mertz had found pathological changes occurring in about 28 per cent of 300 autopsies of patients who have died from other causes. Braasch and Scholl in their study of 144 cases found 54 or 37½ per cent with pathological changes, and for this reason, although no true pathology could be found at the time of examination, yet they thought these anomalies gave greater cause for pathological changes than in the normal kidney. For this reason, and for symptoms mentioned before, partial resection of the kidney had been thought of, but since the degree of function or integrity of each segment was not known, an intravenous injection of uroselectan was done. This showed a normal return of the dye from both segments as well as from the opposite kidney in the first *x*-ray taken twenty minutes after injection.

In spite of all possible data, Bugbee and Eisendrath pointed out that it may be necessary for the surgeon to make his decision at the table as to whether a conservative operation or a nephrectomy should be done, which, as they pointed out, depended upon the blood supply to the various segments, the degree of function of each segment and the extent of perirenal and pelvic adhesions.

Eisendrath pointed out that those cases where the pelvis is completely divided the parts usually have a separate blood supply, the arteries usually arising from the aorta, and the veins extending to the vena cava. However, the diseased segment which is usually the upper may receive only a small branch from the aorta, or from the main renal artery, the main branch of which enters the larger segment and furnishes sufficient blood to permit resection. He showed that the blood supply in 35 cases of double kidney, 15 of these had one artery supplying both segments, and in 15 there was an artery for each segment, and in 5 three arteries supplied both segments.

In spite of all this explanation, the patient refused operation and left the hospital temporarily feeling well, only to return in a short time begging for any measure that would give him permanent relief. Blood examination, blood counts, blood pressure, Wassermann test, were all found to be normal. A two-hour

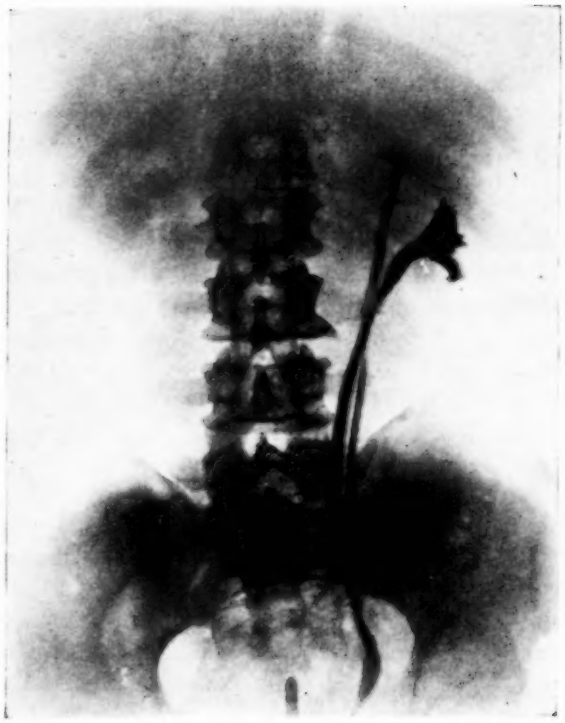

FIG. 1. Retrograde pyelogram showing reduplication of left kidney pelvis and ureter.

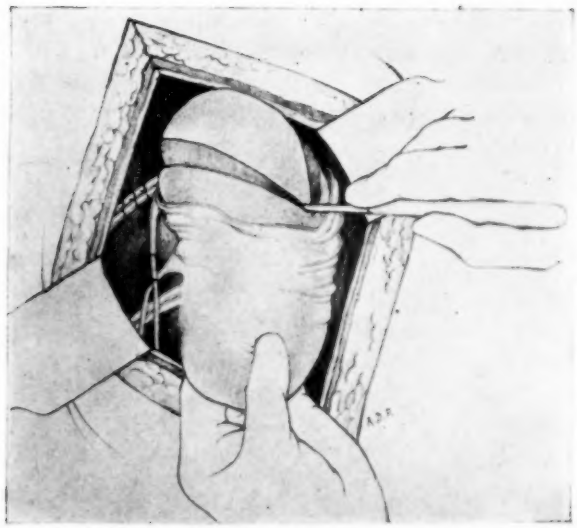

FIG. 2. Partial resection of upper pole of left kidney showing independent blood supply to this segment.

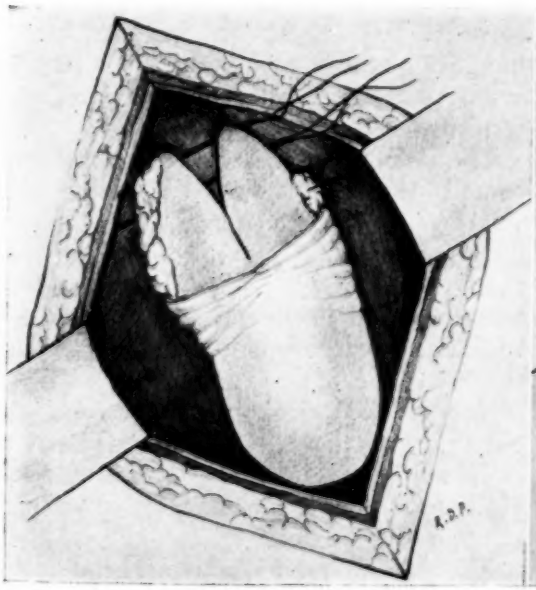

FIG. 3. Closure with mattress suture employing pieces of fat to prevent tearing of renal tissue.

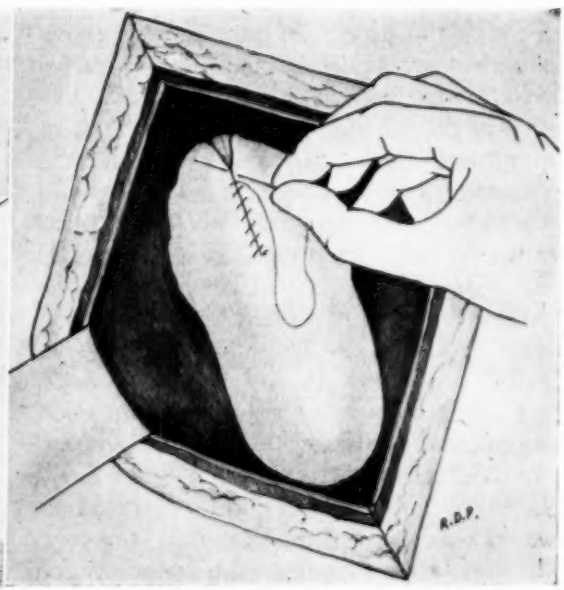

FIG. 4. Replacing and suture of capsule.

phenolsulphonethalein examination showed a return of 25 in the first hour, in the second hour, 12, and combined showed 37.

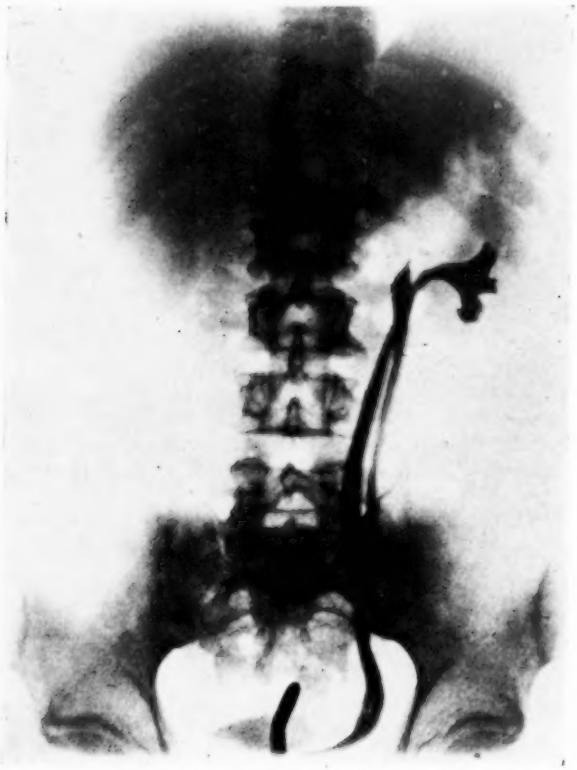

FIG. 5. Postoperative cystoscopy showing reduplicated ureter and single pelvis.

Operation: Operation was performed on August 16, 1930. Incision was made from the left costovertebral angle downwards and almost parallel with the iliac crest just a little above the anterior superior spine. The muscles divided and the renal mass was exposed. The kidney was placed high up under the arch of the diaphragm but with manipulation was brought into the field. The furrow which would indicate the piont of separation of the two renal pelves was absent. Examination of the pelvis showed it to have two distinct ureters; the upper seemed to be under great tension crossing the lower ureter at the pelvouretero junction, and acted probably like an aberrant vessel, where a great amount of pelvic inflammation and connective tissue adhesions were found. The individual parts, including the blood vessels, were not as easily demonstrated as one would believe from the drawing. However, two distinct blood supplies were found, which apparently were independent and had their origin from the aorta and the vein extending to the vena cava. This fortunately made it easier to control hemorrhage in doing a resection of the upper pole.

Before an attempt to ligate the vessels supplying this segment, as well as to ligate the ureter, a decapsulation of the upper pole was performed. We did this because it has been found in a recent experimental study by Herbst and Polkey on dogs that partially nephrectomized kidneys where a decapsulation of that portion of the kidney was first done, and later on employed in closing over, gave much better results than where the v-shaped incision was done without stripping the capsule.

The vessels supplying the upper segment were then tied, as well as the ureter, as demonstrated in the accompanying drawing, and a blanching of the upper pole of the kidney could easily be visualized. This was recently demonstrated by Von Lichtenberg in Dr. McCarthy's clinic. The wedge of the upper segment was then easily removed, care being taken not to enter the pelvis of the lower segment. The control of hemorrhage by mattress sutures which we employed in tying them over small pieces of fat taken from the neighborhood has recently been subjected to criticism by Herbst and Polkey, who claim that of all the methods employed the simple through and through suture as advised by Tuffier after the stripped capsule had been replaced gave the necessary requirements as to control of hemorrhage, as well as not producing a destructive atrophy to the renal parenchyma and therefore a corresponding reduction in the functional qualities of the remaining kidney tissue. However, the capsule was then brought together by continuous suture.

The kidney was then dropped back into the wound, two rubber drains inserted, and the wound closed in the usual fashion. But not until we came to a check-up did we realize that a simple step which could have easily been done and will not I hope cause the patient to suffer another operation, was the lack of removing the cut ureter as far down as the incision would permit, for it has been pointed out that infection of this blind duct may cause as much trouble as the original condition. However, to date no such complication has taken place.

The patient made an uneventful recovery, and was discharged from the hospital three weeks after admission with a slight sinus at

the point of drainage, which has since closed. It is now four months since his operative interference, and for the first time in the past seven years he has been free of any discomforting pain in the kidney area. He has since put on about 15 lb. in weight and returned to work.

A recent check-up to demonstrate the viability of the remaining segment showed a urea content of this kidney now to be 1.4 per cent as contrasted with 1.8 per cent prior to operation. The opposite normal kidney has increased its urea content in the same proportion as the operative kidney has lost. This would fit in with Hinman's work on counterbalance, but we doubt whether enough tissue has been removed to stimulate compensatory hypertrophy. An intravenous indigo dye, however, showed normal return from both sides in about the same concentration. It will be interesting in about a year to make comparative studies as to the percentage of pthalein output of both sides, and compare results of those of other authors.

[For Discussion, see p. 102.]

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RENAL AND URETERAL CALCULI*

SOME PRESENT DAY SURGICAL PROBLEMS

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THE problem of dealing with urinary lithiasis is an ever fruitful subject for discussion. Whether it be the ureteral calculus which tarries too long in its passage through the ureteral channel or massive coral calculi involving both kidneys, the individual case brings its own difficulties which require solution.

That no eminently satisfactory method of dealing with small ureteral stones has yet been found is evidenced by the numerous devices which have been invented for the purpose of dislodging retarded stones and speedily bringing them through a ureter almost too small for their passage. To accomplish this, ureter catheter manipulation is of such common practice that it may be regarded as universal and it is credited with an enormous number of successes. Yet, when we take into account the fact that the majority of small stones will pass spontaneously, the actual value of the procedure must be discounted considerably.

The failures of the method furnish the incentive to look for more reliable means and an array of dilators, crushing forceps, screws, slings, bulbs and the like is the answer.

The suggestion made a few years ago of passing several ureteral bougies past a lodged ureteral calculus and withdrawing all at once in the hope that these bougies had disposed themselves along different sides of the stone and would thus hold it within their grasp and deliver it into the bladder has much to recommend it. By this method the ureter has on two occasions delivered troublesome calculi.

It has an advantage which the more complicated devices do not possess, namely that, should the stone become so tightly wedged that it cannot be brought out without danger of injury to the ureter, the bougies may be removed one at a time.

That the use of the simple bulbous bougie is not without its dangers is shown by the writer's experience in dilating a ureteral stricture behind which a stone was lodged. The bougie was passed through the stricture and beyond the stone but upon the attempt to withdraw the bougie the stone was caught under its shoulder and could not be disengaged. Removal of the calculus through an iliac incision liberated the entrapped bougie.

The length of time in which one is justified in using intraureteral measures naturally varies in wide limits in different cases. The comparative size of the calculus and that of the ureter as shown by urogram, the shape of the calculus, the history of previous passage of urinary calculi, the impairment of renal function, evidences of serious infection during attacks of ureteral occlusion, and the general physical condition of the patient are the factors for consideration in the individual case in deciding upon operation or persistence in intraureteral manipulation. Calculi of unusual size lodged in the lower ureter near the bladder almost always require operation, yet there are occasional exceptions, which the following case will illustrate.

CASE 1. A man forty-two years old whose stone-bearing history covered a period of twenty-five years, showed by *x*-ray examination two large calculi in the lower right ureter. The shadows were about equal in size and measured approximately 7 by 15 mm. The ureteral orifice was enlarged with cystoscopic scissors, and rectal massage given in an effort to dislodge the calculi. Shortly afterwards one of the stones passed into the bladder and was removed by litholapaxy. In a few days the second stone was passed into the bladder and it also was crushed and removed.

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Enlargement of the ureteral orifice for the release of a stone engaged in the intramural portion is more satisfactorily accomplished by surgical diathermy than by incision as hemorrhage is thus avoided and the sear is less.

The value of cystoscopic methods in aiding passage of ureteral calculi is expressed in a recent report by Squires[1] of the Crowell Clinic. Of a total of 606 cases the calculi were recovered by cystoscopic methods in 528 or 87.13 per cent.

Caution must be observed in dealing with a migrating stone, and especially should one not delay surgical removal when there is evidence of advanced pathology in the kidney.

The following case illustrates some of the difficulties encountered in dealing with a migratory calculus and emphasizes the danger of intraureteral manipulations in the presence of stones of this character.

Case II. In a man of fifty-six years, suffering with renal colic, the *x*-ray showed a stone 0.5 cm. in diameter opposite the right transverse process of the fourth lumbar vertebra. A ureter catheter was obstructed at this point. Albolene was injected into the ureter and the attack gradually subsided. Ten days later *x*-ray showed the calculus in the kidney pelvis. Shortly afterwards he had another attack of colic with fever and reduced urinary output. He developed hiccups. *x*-ray now showed the stone to be about 4 cm. from the bladder. The ureter was catheterized, lavage given and the catheter fixed. Hiccups ceased and the general condition improved. Ureteral dilatations were performed at intervals of seven to ten days and drainage maintained for brief periods afterwards by indwelling ureteral catheter. *X*-ray showed the stone at one time in the ureter and at another in the kidney pelvis. After the fourth treatment he developed fever, rapid heart, rigid abdomen and failed rapidly and died three days later. Autopsy disclosed acute peritonitis centralized about the right kidney. The kidney contained multiple abscesses. No injury could be demonstrated in the ureter or renal pelvis. The ureter was dilated except near the bladder, and contained a small stone which was freely movable throughout the length of the ureter.

When a calculus obstructs one ureter and anuria occurs, if a single manipulation fails to establish drainage immediate surgical intervention is usually indicated. Exceptionally secretion of urine may be reestablished by stimulating measures and operation delayed for a more favorable condition of the patient. In one such case, the anuria being of fifty-two hours' duration, copious secretion of urine followed stimulating measures and removal of the obstructing calculus was delayed until the fifth week after the anuria occurred.

In the presence of bilateral stones, although intraureteral measures may result in some downward progress of the stone, sudden complete occlusion of both ureters may occur, producing a similar problem and surgical removal of the obstruction becomes imperative.

When operation for the removal of a ureteral stone is undertaken, damage to the kidney may be so advanced that nephrectomy is indicated, yet the impairment of function of the other kidney may make the procedure inadvisable. In certain instances the repair is remarkable in what seemed a hopelessly diseased kidney, after drainage has been reestablished through removal of the stone.

Renal stones requiring operative removal are not sufficiently similar to permit the adoption of a routine procedure. Most urologists prefer pyelotomy to nephrotomy, especially in cases of small or medium sized stones in the pelvis of the kidney or accessible calices. Stones of considerable size, even those having branches into the calices, may be removed by enlarged pyelotomy[2] without incurring the dangers which commonly attend nephrotomy. By corrosion models Deming[3] has shown that enlargement of the pyelotomy incision may be extended straight into the kidney or to the lower pole without impairment of the circulation of the kidney if the retropelvic vessels are conserved.

It is not assumed that all renal calculi are amenable to operation by this method. For the coral-like stone, for the calculus

exclusively renal, or the multiple disseminated stones deep in the calices, it is evident that this operation will not be sufficient but may need to be augmented by small nephrotomy incisions to liberate small stones or fragments lodged in the calices. For the stones of the pelvis that are prolonged into the kidney, enlarged pyelotomy will often suffice for their delivery. Naturally there should be a radiogram that demonstrates clearly the characteristics of the stone and which leaves no doubt as to its shape and its direction, but shows equally well the absence of fragments situated a little distance away or in totally different positions.

In cases of bilateral renal calculi of the branched or staghorn or giant type, there is often no pain, the patient suffering from septic absorption.

In deciding on operation, one will consider whether the removal of the calculi involves greater destruction of kidney tissue than will result from the presence of the calculi or whether probable improvement following removal of the stones justifies the risk. A stone free in the pelvis, causing intermittent obstruction, may require first consideration. The development of acute infection may demand immediate action.

Generally the kidney with the better function should be operated on first to conserve to a maximum its function before operating upon its fellow. This opinion is best applied in the case where one kidney is almost completely destroyed and the other has fair, or good function. There are many exceptions to the rule.

Multiple calculi in different parts of the urinary tract may be present in addition to bilateral renal stones, i.e., in the ureters, the bladder and the urethra. Unless there are contraindications those stones in the lowermost position in the urinary tract should be removed first. No rule can be laid down as each case must be handled according to its individual peculiarities. Likewise the time of operation calls for the exercise of good judgment. Postponement in one case may give an opportunity for improvement, whereas delay may result in a hopeless state that might have been avoided by an early operation. It is important not to undertake too much at one operation.

Many of these patients suffer from the presence of incurable infection of the urinary tract and the most one can hope for is to minimize the infection and relieve pain. Although many of them are incurable they may derive great benefit from a well planned and carefully executed program of operation and gain several years of comparative comfort.

Several lesions may exist in a single kidney giving rise to similar symptoms. We should not be content with a self-evident diagnosis as renal stone, and overlook the presence of coexisting pathology.

In a survey of 1817 cases of renal tuberculosis at the Mayo Clinic Crenshaw[4] found renal calculus associated with renal tuberculosis in 1.8 per cent of the cases. This datum may be taken as indicative of the relative occurrence of such combined pathology. Four cases of renal stone associated with renal tuberculosis have been observed among our cases. In 1 case a shadow in the upper pole was mistaken for calcification in reading the *x*-ray. After nephrectomy the specimen was found to be that of a tuberculous double kidney, the upper pelvis of which contained a calculus.

Case III. A particularly interesting case was that of a woman (Mrs. G.) forty-eight years of age, who, in a period of twenty-two years, had recurrent attacks of hematuria, numerous attacks of renal colic, followed by the passage of calculi, nephrotomy for kidney stone, and spontaneous rupture of a loin abscess, the sinus persisting many months. She was referred to us by Dr. W. N. Taylor of Columbus, Ohio, who had diagnosed left calculous pyonephrosis and exophthalmic goiter. The right kidney was normal. Through a lumbar incision a large pyonephrotic kidney, containing several large calculi, was removed with great difficulty, a capsular enucleation being necessary. The pathologist's report showed, in addition to the general destruction,

due to pyonephrotic changes, several areas in the remnant of renal parenchyma which contained giant cells and tubercles.

Operation upon a solitary kidney is attended by considerable apprehension by both the surgeon and the patient. Keyes[5] has made the observation that the removal of uncomplicated stone from the pelvis of the solitary kidney in 6 cases shows that these patients stand operation almost as well as patients with two kidneys. Walters[6] of the Mayo Clinic, found record of 45 cases of solitary kidney in which operation upon the kidney or ureter had been done for the removal of calculi. The mortality was 13.3 per cent.

Four of the writer's cases of calculus in solitary kidney have been treated. One of them was in a young physican who had lost one kidney by emergency nephrectomy soon after a calculus had been removed by nephrotomy. A year or two later he had anuria due to a calculous obstruction of the ureter of his remaining kidney. We succeeded in passing a catheter beyond the calculus and relieved the retention. Shortly afterwards the stone was passed.

In another case of a young man who had lost a kidney by operation for calculous pyonephrosis a stone formed in the remaining kidney. This stone was of the migrating type. After several efforts to cause it to pass by catheter manipulation, ureter dilatations, etc., operation was undertaken after a catheter had been passed to make sure the stone would remain in the kidney during operation. Through a pyelotomy incision attempts to find the stone failed and much effort was expended by way of irrigations to flush it out but did not succeed. Finally, in acknowledgment of failure, a drainage tube was inserted through the cortex and the kidney replaced. The prolonged operation added too much to his already overtaxed kidney and he died, uremic, four or five days later.

The use of the fluoroscope to locate a stone during operation is not always feasible, as was demonstrated in this case in which a short renal pedicle in a fat subject made the procedure entirely unsuccessful.

Case iv. Mrs. M, a woman of thirty-four, was one of the cases of nephrectomy for calculous disease associated with tuberculosis. Prior to removal of the left kidney in May, 1929, a pyelogram of the right showed it to be normal. Six months later the *x*-ray showed the right kidney filled with stone. The film was an exact duplicate of the previous pyelogram. In February, 1930, she was again admitted to the hospital with anuria of forty-eight hours' duration. Efforts to catheterize the right ureter failed. Emergency nephrotomy was performed, numerous stones removed and nephrostomy drainage established. In November, 1930, *x*-ray showed recurrence of calculi. The sinus was dilated and several masses of calcareous material were removed. Future management of the case will be guided by whatever emergency arises. The outlook is manifestly far from being hopeful.

Cases in which urinary calculi cannot be demonstrated by *x*-ray are diminishing in number as *x*-ray equipment is improved and as our methods of applying *x*-ray are modified to intensify shadows or to demonstrate filling defects. Very small calculi frequently do not give a shadow by *x*-ray and this group furnishes most of the 10 or 15 per cent of cases of renal colic in which the *x*-ray examination is negative, though stone is diagnosed by wax tipped catheter. In such a case where the stone does not pass promptly, more intensive application of *x*-ray study will usually show either a shadow or a rarefied area in the urogram. Larger stones occasionally are not demonstrated in the *x*-ray.

Two cases of cystinuria with calculi have come under our observation, both in boys, one eighteen and the other sixteen years of age.

In the first no shadows were obtained by *x*-ray though several calculi passed spontaneously and an accumulation of small stones in the lower left ureter required operative removal. During convalescence from the operation colic occurred on the opposite side accompanied by anuria. Ureterolithotomy was again necessary for

removal of a stone lodged in the right lower ureter.

In the second case (C. F.) the stones were also bilateral. From the lower left ureter a calculus was removed by ureterolithotomy and at a later operation the right kidney, a large calculous pyonephrosis was removed. This kidney had been operated upon seven years before for stone. These typical slightly translucent cystine stones gave good shadows to *x*-ray.

Calcified lymph glands in the region of the kidney are occasionally the cause of confusion in diagnosis where stone is suspected.

Several cases of renal calculus are recalled in which gallstones also were present but the position of the gallstone shadows in the *x*-ray gave no cause for doubt as to their identity.

Rapid formation of stone in the septic bladder is a matter of common observation, and the same is also true within the kidney. Marked interference with drainage accompanied by infection would seem to provide the condition most likely to give rise to rapid accumulation of calcareous material.

The case previously mentioned of the woman who had lost one kidney affected with calculous disease and tuberculosis, had what seemed to be a normal condition of the opposite kidney at the time the nephrectomy was done, yet within six months the remaining kidney was filled with stones.

Case v. Mr. S. Large branched stones were removed from both kidneys by enlarged pyelotomy. When first observed the concretions were small, not larger than a bean in one kidney, and in the other a small speck of calcified material. On one side the ureter was strictured near the ureteropelvic juncture. In this kidney the stone grew more rapidly, filling the pelvis in nine months; the other kidney was filled in twelve months. Removal of the stones and dilatation of the stricture of the right ureter, and the clearing up of foci of infection in teeth and tonsils have cured his urinary infection. During the period of a year we observed rapid formation of bilateral kidney stones, notwithstanding that the patient was under close observation and regulation as to habits, diet, medication, etc.

Hunner's assertion that renal calculi are secondary to ureteral stricture finds support in the condition of this man's right kidney, but it cannot be said to be true of the left kidney where stone formation was equally rapid.

Braasch[7] has suggested that to the various types of urinary calculi described in the literature should be added a form of pseudolithiasis which he calls hysterical lithiasis. This unusual manifestation of an abnormal psychological process is shown by symptoms simulating those of acute renal colic. In order to complete the deception the patient will produce a stone shortly after the colic, which, to the casual obser ver, may be mistaken for urinary calculus.

One of our cases, a young woman (Miss D.) described her attack of colic in all of its harrowing details and produced the result of her travail, which she had fished from the chamber. It proved to be a fragment of a parched grain of popcorn.

Case vi. Mr. G.'s case, thirty-nine years of age, who came to us June 21, 1927, was more difficult of solution. He gave a history of attacks of lumbar pain somewhat resembling renal colic and stated that he had passed 11 stones, 3 in one month. For ten weeks no stones had passed but there were evidences of one in the bladder which seemed to come down into the urethra and remain there. His physician said that he had displaced it into the bladder by instrumentation but was unable to get the urethra sufficiently open for the stone to pass. Upon exploration of the urethra a stone was detected in the bulbomembranous portion. Through an endoscope the stone was caught and extricated with urethral forceps. He was urged to go to the hospital for complete urological examination upon the ground that the lumbar pain which had preceded the passage of each stone suggested the origin of the stones as being renal and that the renal side of the diagnosis should be carefully worked out. He decided to return home. His physician reported by letter that he had extracted two more stones, one on June 27 and the other July 2. On August 2, 1927, the doctor wrote, "That

man still passes stones and number 21 is now in the deep urethra and I am not able to get it out. Eight have passed since he was at your office. But there are no indications that they pass from kidney to bladder—just through the urethra." He entered the hospital on the afternoon of October 18, 1927 for urological examination. The usual blood count, urinalysis, and kidney function tests were made. The following forenoon he left the hospital without permission, but before going he told one of the doctors that in the morning he felt the stone drop into his bladder. He produced a stone but its appearance caused great doubt as to its having originated in his urinary passages. He had no colic while in the hospital and received no morphine.

On March 12, 1929, he reentered the hospital on account of morphinism. The pulse and temperature, blood pressure, blood count, phenolsulphonthalein and urinalysis were all within normal limits.

After several days' observation it was decided his condition had improved sufficiently to proceed with his urological examination. He seemed to sense the significance of certain preparations and quietly slipped out of the hospital. We have not seen him since.

Case vii. A middle-aged woman who had previously been operated upon for renal calculus, came to the Indianapolis City Hospital periodically for removal of bladder stones. Some were small and could be removed with a stone evacuator without being crushed while others had to be crushed. On one occasion cystoscopic examination showed what appeared to be a flat, dirty white stone lying on the floor of the bladder. Upon prodding it with a ureteral catheter deep indentations were made. The whole mass was pumped out with the stone evacuator, and the material was sent to the chemist for examination. The chemist reported the material to be composed almost entirely of calcium sulphate.

The nurse was instructed to observe if she had visitors and what was brought to her. Within a few days her little daughter brought a paper sack containing white powder which the patient said was tooth powder. It proved to be plaster-of-Paris. Being thoroughly frightened over the exposure and the fear of prosecution by the insurance company which had paid weekly benefits for a long time, she told us how the deception was carried out. At first she used a catheter which she would fill with the plaster-of-Paris paste and after inserting the catheter into the bladder, would strip it backwards forcing the paste into the bladder. At other times when a catheter was not available the same performance was accomplished with a strip of paper rolled into a tube.

Case viii. A student nurse (M. McC.) whose urological examination was negative and whose attacks of renal colic suggested hysteria, was told it seemed strange that her attacks always occurred at night and that none of the stones were recovered. Within a few days she had another attack and this time produced a "stone" for our inspection. It proved to be a small piece of cinder.

In conclusion, the various topics may be summarized as follows:

1. Delayed passage of small ureteral calculi may often be facilitated by ureteral instrumentation, either with the ureteral catheter or bougie or specially devised instruments.

Such manipulations are not wholly without danger.

The migrating ureteral calculus is always a cause for worry, being capable of seriously frustrating efforts for its removal.

Calculi of unusual size lodged in the lower ureter frequently require operative removal either by ureterolithotomy or ureteral meatotomy. Ureteral meatotomy by surgical diathermy is preferable to that by incision.

2. All urologists recognize that bilateral renal calculi usually manifest a state of advanced renal infection, seldom of the same duration in the two kidneys, hence an unequal degree of renal impairment, and present problems that demand the exercise of trained judgment in the adoption of a program of surgical interference.

Calculus in the solitary kidney is cause for apprehension, the risk of operation being dependent upon the function and the degree of infection.

The combination of stone and renal tuberculosis is rare and it may be inferred that in such instances the stone is the primary lesion.

3. Difficulty of diagnosis of renal and ureteral stones by *x*-ray is most common when the stones are very small, and especially when composed of uric acid. Cystine stones are sometimes transparent to *x*-ray. The urogram will often make visible a stone transparent to unaided *x*-ray. The "staining" quality of certain media, such as sodium bromide, sodium iodide, uroselectan and skiadan, has been found helpful.

Extrarenal shadows may usually be differentiated by the lateral *x*-ray and pyelogram and stereoscopy.

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DISCUSSION OF PAPERS BY DRS. LUBASH AND HAMER

Dr. Clarence G. Bandler: While cases of renal and ureteral calculi are not encountered frequently, one hopes to find a case having a separate blood supply to the affected portion of kidney, such as Dr. Lubash demonstrated. Just today, in our department at the Post-Graduate, we encountered the second case in a few months, of ureteral and renal pelvic duplication, with but a single ureteral orifice, in which the patient presented the picture of hydroureters with pyohydronephrosis. Of course, in this case, nephrectomy with ureterectomy is indicated.

Dr. Hamer has given us a very complete and interesting résumé of ureteral and renal lithiasis, in which he shows that these problems in Indiana, in no way differ from similar problems elsewhere. In reference to small stones in the ureters, it is a well known fact that about 70 per cent will pass spontaneously, or assisted by some form of intraureteral manipulation. Dr. Hamer's quotation from the statistics of the Crowell Clinic, whereby they obtained calculi by ureteral manipulation in 87 per cent of their cases, is extremely interesting, and amply illustrates the reward of patience. I believe all of us have employed multiple catheters, ureteral spindles, wire corkscrew manipulators, dilating bougies, ureteral bags and numerous other devices with some success; however, I am convinced that ureteral catheters and bulbous bougies are more frequently useful in manipulating stones out of the ureter through dilatation, than other types of ureteral instruments. If ureteral calculi are apparently fixed in their positon, and even their axes cannot be changed by intraureteral manipulation, I believe that ureterectomy should be performed rather than allow these stones to remain fixed so long that irreparable renal damage may occur.

It is surprising how readily some very large calculi may be manipulated from the lower end of the ureter. No doubt, most of you recall a case presented before the urological section last year, by Dr. Dourmashkin, in which, with his dilating bag, he was successful in manipulating a calculus, 1½ in. long, out of the lower end of the ureter. You may also recall that at the same meeting, another gentleman presented a calculus fully 2½ in. in length, and irregular in shape, which also had been manipulated out of the lower end of the ureter.

In patients with bilateral ureteral calculi, one cannot afford to spend so much time in manipulation as with unilateral cases. If there is not a reasonably prompt response to intraureteral manipulation, surgical intervention is indicated. Dr. Hamer's reference to extensive bilateral renal calculi, and his enunciation of the principle that it is usually preferable to operate upon the better functionating kidney first, are reasonably tenable. However, the apparent facility of removal of such stones should have greater weight in influencing our judgment. With this in mind, we not infrequently operate upon the poorer functioning kidney first, with more satisfactory surgical results. I am convinced that some patients with multiple or large branched calculi in each kidney, live longer if no surgery is performed, than if they were subjected to the great risk of surgical intervention.

With the modern urologic tendency toward conservative renal surgery, it is surprising how many kidneys with multiple calculi or large branched calculi may be saved, where, formerly, it was common practice to nephrectomize these organs; now pyelotomy with intrapelvic manipulation and removal of these stones is very frequently successful. Occasionally, through a pyelotomy incision, a branched calculus may be crushed with a rongeur, and the fragments removed from the kidney. Kidneys with little or no renal function, as measured by dye output, will frequently return to a moderate and useful degree of renal activity. Dr. Hamer has referred to the coincident existence of lithiasis in cases of renal tuberculosis, and has quoted Crenshaw's statistics of 1.8 per cent of such cases in a large series at the Mayo Clinic. I do not believe renal calculus in these cases offers a separate surgical problem, but that the surgery indicated for the renal tuberculosis should also be that of the lithiasis. For instance, I doubt if in bilateral renal tuberculosis with a coincident calculus in one kidney that there would be any separate surgical indication for the treatment of the calculus.

Dr. Howard S. Jeck: Dr. Lubash stated that he regretted not having removed the ureter corresponding to the kidney pelvis in his heminephrectomy for fear that the ureter might later give rise to trouble. I believe, in this connection, he has little or nothing to worry about for the great majority of cases of empyemas of the ureteral stump occur in cases where stones have been left in the ureter or where there is some other form of obstruction. His case apparently had no ureteral stone and as far as I could tell from the urogram, there was no obstruction below.

Dr. Hamer referred to methods of removing ureteral stones by means of various devices, some of which actually grasp the stone. I well remember my experience with the flexible bougie that had a sort of a corkscrew at the end. The stone is supposed to be entangled in the coils of the corkscrew. The first time I used this instrument, I had beginner's luck. Within two minutes after I had started, I removed the instrument together with the stone and said, "What a bright boy am I." But the next time I tried the same instrument I thought I was going to remove the whole lining of the urethra before I could pull the instrument out and I have therefore never used it since.

Some years ago at Bellevue, in another stone case, one of our men passed up the ureter a flexible metallic instrument with a head shaped a great deal like a spermatozoan. When the instrument was removed, the head remained in the ureter as was beautifully demonstrated by the *x*-ray. However, this particular foreign body passed out spontaneously within a few days.

Concerning operations for bilateral renal calculi, Dr. Hamer quoted the rule, which is usually followed, of operating on the better kidney first. Dr. Bandler also substantiated Dr. Hamer's remarks. We all agree that there are exceptions to this rule and one of the most striking exceptions I think is well illustrated by a patient on whom I recently operated at Bellevue. There were stones in both kidneys, the function of which was very poor. However, the left kidney was functioning somewhat better than the right. In this case I chose for the first operation the kidney with the poorer function (right) on the ground that had I operated upon the left kidney first and had nephrectomy become necessary, the right kidney probably could not have sustained life. And I doubt very much if the patient would have lived had only a nephrotomy on the right side been necessary. Incidently, as it turned out, the kidney and ureter were so friable that in trying to remove the stone, the ureter was accidently pulled in two at its junction with the renal pelvis. But fortunately an anastomosis between the ureter and kidney pelvis performed immediately after the stone was removed saved the day as well as the kidney.

In operating on a single kidney containing a stone, I think the point brought out by Dr. Keyes in his recent article on the subject was very well taken, namely, that we can probably operate successfully on more of these cases than we do. He ascribes his success to being more careful than when the patient is possessed of two kidneys and also to the fact that such a kidney being already infected, there is less likelihood that a severe acute infection will ensue.

Another of Dr. Hamer's points that I think is worthy of emphasis is the fact that every renal or ureteral stone case, particularly the latter, should be *x*-rayed immediately before the operation. Ureteral stones have a habit of changing their position on short notice and to

my sorrow I have operated upon at least 2 patients in whom the stone was in the kidney pelvis at the time of the operation when it was shown to be well down in the ureter by an *x*-ray taken a day or two before the operation.

In operating for kidney or ureteral calculi, particularly the latter, I think it is of the greatest importance to try to open the ureter immediately over the stone. It is difficult to fish a stone out through a ureteral wound which is made several centimeters above or below the point where the stone lies. A good rule to follow is that once having gotten your fingers around a urinary stone, not to turn loose until you actually have the stone out.

Dr. C. R. O'Crowley: In regard to heminephrectomy: When Dr. Papin of Paris was here last June, at the close of the Urological Meeting in New York, I gave an operative clinic at the Newark City Hospital, at which Dr. Papin did a heminephrectomy and I assisted him. The patient was a woman twenty-four years old with a double pelvis kidney with two ureters that bifurcated about 6 in. below the kidney. The lower portion of the kidney had a small abscess cavity containing a small calculus. He did a beautiful resection in this case by removing a large wedge-shaped portion of the lower pole and then sewed with number zero catgut a small opening into a calyx. A fat pad was placed in the wound and the kidney and capsule closed over it. The operative wound was closed without drainage. A few days following operation she had a chill with rise of temperature and it was necessary to open the wound slightly, let out some pus and insert a drain. She drained pus and then urine for some time and finally the wound closed. She left the hospital and a few weeks after the wound opened up again and she returned to the hospital at which time we treated her the same way and at the same time did a uroselectan study of that kidney. It showed that a small portion of that lower calyx was still there and was communicating both to the middle calyx and through the lower pole. I believe eventually the kidney will have to come out.

This is not a hazardous operation and I think more of such operations ought to be done in ideal cases.

Those of us who have had a large experience in nephrolithiasis have come to some very definite ideas which are not very far removed from those stated by Dr. Hamer. It is true that a very large percentage of stones pass of themselves and that the remaining percentage can almost always be encouraged to move by the various methods of intraureteral manipulations we are accustomed to, but I believe that all of these manipulations should show some result and that operation in some cases should not be put off too long, particularly, in those cases where we can demonstrate that manipulations, colics, and all forms of treatment have failed.

It is my opinion that in cases with calculi in both kidneys, it is wiser to operate upon the better kidney at first in order to raise its standard in case you operate later on the opposite side and may be compelled to do a nephrectomy.

Dr. J. Sturdivant Read: I agree with Dr. Hamer that the removal of ureteral stones can generally be accomplished by manipulations with a ureteral catheter. Stones in the ureter which will allow the passage of a catheter alongside them can be assisted in their passage by allowing the catheter to remain in situ one or two days. In my own clinic, we are impressed by the mechanical ingenuity of some of the instruments advocated for the removal of ureteral stones. Frequently we think their advocates forget the delicacy of the mucous membrane and the small caliber of the ureter. I must say that most of these mechanical contrivances are now museum specimens. Fifty per cent of ureteral stones will be passed spontaneously and this should be taken into account in discussing the removal of stones by various manipulations.

The subject of closing the skin wound after nephrectomies has been mentioned. I have never seen any such wound delayed in healing up by putting in a drain, and I think it best that a drain should be used in every case. Where this is not done, there are about 2 per cent in which when the skin wound has healed, pus would accumulate in the bed of the wound and burrow in the wrong direction and not be discovered for a long period. Sometimes it necessitates a real operative procedure for its relief.

Records from our clinic at the Long Island College Hospital of 102 successive stone cases, show that there were 47 per cent right, 38 per cent left, bilateral 11 per cent. Of this, 70 per cent were in males, 31 per cent in females. Of these 102 cases, 58 came to operation; 28 nephrectomies, 23 pyelotomy, 1 pyelonephrot-

omy, 3 nephrostomies. The necessity for the suspension of the kidney after pyelotomy was thought to be indicated in 3 of these cases only.

Fig. 1.

Fig. 2.

The routine suspension of kidneys after pyelotomy is unnecessary. In the analysis of 13 cases of bilateral stone, 5 were nephrectomies on one side and later a pyelotomy was done. There were no deaths. The 3 nephrostomy cases were all in women, ranging in age from forty-eight to sixty-three, in which there were large branching calculi of each side. Pain was so great and sepsis so profound, that relief was sought. One died the fifteenth day postoperative of interstitial nephritis. The second died the same day, and the third, aged forty-eight, made a remarkable recovery though at the time the picture was one of intense pain and profound systemic retention. Yet she is now vigorous and well after six months' period. Generally it is wise in cases of large branching double calculi not to operate except for severe pain or great sepsis. I believe that regular dilatation of the ureters and lavage of the kidney pelvis retard the rate of progress of kidney destruction.

When to save a badly infected kidney in which there is a large branching calculus or many large calculi must always be a matter of individual judgment of the specific case. The damaged kidney may be improved for one to two years, but generally a secondary operation because of surgical difficulties is a much greater hazard. Also in our experience there is apt to be a recurrence of calculi in one to two years, so that if either kidney is undamaged except for the presence of a single small stone, we prefer nephrectomy. A case in point is a man, aged forty-nine, in whom eleven years ago 3 large phosphatic calculi were removed from the kidney. It was necessary to injure the kidney parenchyma while doing this. After two years, *x*-ray shows recurrence of this phosphatic calculi. There has been a permanent renal fistula which at times closes and produces systemic symptoms. After four years the left ureter became blocked by fibrotic and calcareous material at the junction of the ureter and pelvis. This has been a constant source of damage and has made the man a semi-invalid. The small calculus on the other side has not increased in size during these eleven years, and has given no pain or hematuria, though there is a moderate number of pus cells always. This kidney has been lavaged once in four months regularly.

The second case is that of a man now aged

fifty, with double calculi, who was seen nineteen years ago and has been under constant observation since. There were 2 large phosphatic

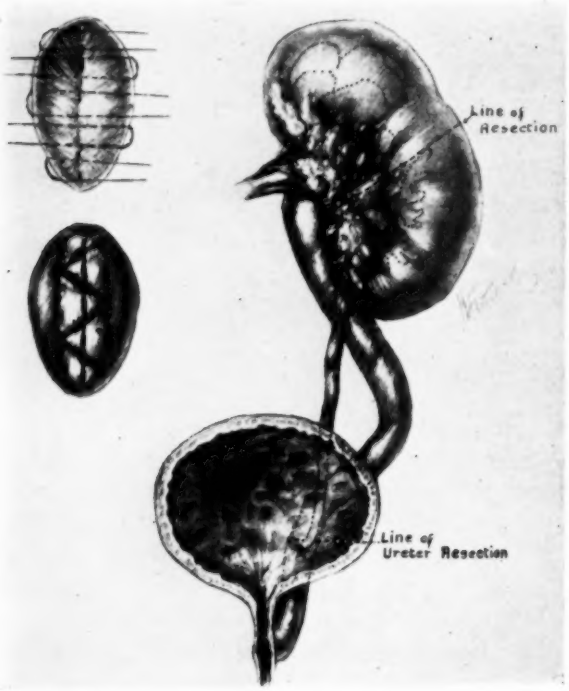

Fig. 3.

calculi on the left side and a nephrectomy was done. Two years later a pyelotomy was done on the remaining kidney. There was no postoperative shock. There has never been any recurrence. The patient has been in perfect health. This man is lavaged once in six months regularly.

We doubt if there is such a thing as a silent stone. All of these patients have some sort of pain at some time, mostly a dull backache to which they become so accustomed that unless a very careful history is taken, they will state that they never had any pain in the affected side. In the presence of regularly appearing small amounts of pus cells, and clear urine which has been secured by catheter, separate kidney urines should be secured, and if the pus should prove to be consistently from one side only, the presence of stone should be diagnosed even if *x*-ray findings are negative. This does not necessarily mean surgical procedures, but it does mean dietetic measures, occasional urinary antiseptics, and bi-yearly dilatation of the ureter with lavage of the pelvis.

Dr. Edward L. Keyes: The fundamental physiological fact in relation to ureteral stone is that the stone advances only during periods when there is no colic or pain. These symptoms mean retention, and the most certain way to make all ureteral stones pass would be to perform bilateral pyelostomy. The relief of back pressure, when this operation is performed for the relief of calculous anuria, permits the silent passage of extraordinarily large stones. Conversely manipulation calculated to irritate the ureter will, if anything, delay the passage of the stone. Obviously not all stones that pass after ureteral manipulation can be credited to the manipulation. I have had no luck with the passage of several catheters up the ureter to expedite passage of stone. A single catheter seems to do as well. Indeed in most instances, there is no need to interfere at all.

Dr. Meredith F. Campbell: I have here the urograms in 2 cases which I thought might be of interest in connection with the first paper. The patients were both infants. I will not go into the details of the cases.

The first urogram (Fig. 1) is in a patient six months of age with a history of pyuria since birth. This is a "cystogram." It is obvious that an anomalous condition exists. It was found that the catheter entered a ureteral orifice on the floor of the mid-urethra. The second urogram (Fig. 2) shows the right pelvis injected and normal. The lower left renal pelvis is injected and normal and the catheter in the ectopic ureter shows a hydroureter and hydropyonephrosis of the upper pelvis. The urine from this upper left pelvis was milky with pus and functional tests indicated a dead kidney segment. The lower half and right side were normal. Heminephrectomy of the upper left kidney with ureterectomy down to about an inch from the urethral opening was successfully carried out (Fig. 3). The child's urine is now clear and sparkling and pyelogram taken one year postoperatively indicates a normal lower kidney pelvis.

The second case is that of a child first seen at the age of five weeks with a history of pyuria since birth. The urine was grossly purulent and at the age of six weeks the child was cystoscoped and it was determined that a congenital stricture of the left ureterovesical junction existed with infected hydroureter and nephrosis above. The kidney was functionally dead. On the right side there was a complete reduplication of the urinary tract with ureterovesical junction stricture and dilatation of the

uretero to the lower pelvis, normal function and urine. Repeated search for a second ureteral orifice on the left side was fruitless till two years later. In the meantime conservative dilatation of the stricture by passing of multiple catheters served to restore partial kidney function and diminished infection. There were, however, periodic attacks of so-called "acute pyelitis." With the finding of the two ureteral orifices on the left side and the determining of a good functional upper left kidney half, ureteroheminephrectomy of the lower segment was successfully carried out (Fig. 4). The child is now cured except for a persistent urinary infection originating in the lower half of the right kidney.

Dr. S. Lubash (*closing*): As to Dr. O'Crowley's remarks regarding the heminephrectomy that was performed at his institution by Dr. Papin, I should like to point out that in Dr. Papin's recent talk before the American Urologic Association on conservative surgery he made mention of the fact that it was better to remove not only the diseased portion of the kidney, but to go beyond into normal areas rather than leave any of the infected material behind which would cause trouble in healing. This was also brought out by Judd in his very memorable work reported back in 1915.

Dr. Hamer, (*closing*): The discussion has brought out several points in regard to the spontaneous passage of ureteral calculi. Doubtless many of the patients who have been subjected to ureteral catheter manipulations would have passed their stones had no instrumentation been done. Yet there is ample evidence that the measure is entitled to much credit. Dr. Squire had record of 606 patients of whom 528 passed their stones following ureteral manipulations; 44 were operated on and 34 did not return. If Dr. Squire had been less modest he could have said that of the 572 patients treated 92 per cent passed their stones after ureteral manipulations.

Dr. Read's observation concerning fixation of the kidney after removal of a stone recalls an experience I recently had. After removal of a calculus by pyelotomy we were unable to find the ureteral outlet, and it developed that the ureter was angulated and bound down by adhesions. When these were broken up the ureter was freely open. I did not regard it as necessary to anchor the kidney. It was not so much the position of the kidney as the adhesions which caused the obstruction of the

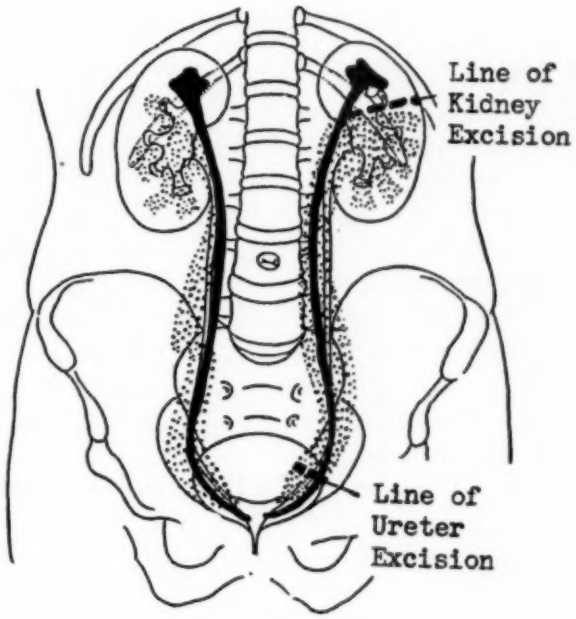

Fig. 4.

ureter. Maintaining the kidney in the normal position during convalescence probably accomplishes the same results as fixation. However, fixation should be done when indicated.

Conservatism in surgery of the kidney in bilateral stone is receiving much discussion at the present time. We are often in doubt whether pyelotomy, nephrotomy or nephrectomy should be done. The case of a young man with a large stone lodged in the mid-ureter of the right side and several large stones in the left kidney, illustrates this uncertainty. We removed the stone from the right ureter and drained the kidney by a small tube through the cortex. There was no urine from the bladder for several days and we were in doubt as to whether the left kidney had sufficient functional ability left to justify removal of its stones or whether it should be sacrificed. The left ureter was catheterized and it was found the kidney had some ability to excrete phthalein. The stones were removed and the kidney drained through a nephrostomy tube. The infection cleared up and the patient made a pretty good recovery but he has had a recurrence of stone on that side. Perhaps it would have been better to have removed his left kidney.

CARE OF THE NEUROSURGICAL CASE*

S. Bernard Wortis, M.D.

NEW YORK

THE technique of surgical attack on the nervous system has been amply and often described by many masters. Such technique can only be created and applied by a surgical expert. However, the care of the patient before and after operation is equally the responsibility of physician and surgeon; it is of the first importance therefore that a procedure to that end, uniform, comprehensive and irreducible, be known to both physician and surgeon; and used.

We have set down here the method evolved, and now obligatory in the Neurological Department, Bellevue Hospital.

ROUTINE FOR ALL SURGICAL CASES

1. Complete medical examination (heart, lungs, rectal, vaginal).
2. Examination by neurologist. Obtain his signed opinion in favor of operation.
3. Temperature (rectal) every four hours, two days preceding operation.
4. Urine to laboratory, preoperative and postoperative and every week thereafter.
5. Blood typing. Save serum for cross agglutination.
6. Blood coagulation time.
7. Blood Wassermann test.
8. X-rays. Brain cases anterior, posterior and lateral stereoscopic views of skull. Spine cases anterior, posterior and lateral stereoscopic views of spine. Peripheral nerves anterior, posterior and lateral stereoscopic views of traumatized limb.
9. Never use hot water bags, hot pads, poultices or lighted cradles.
10. Signed operative permit.
11. Urotropine grains x plus sodium acid phosphate grains x, t. i. d. postoperative on catheterized cases.
12. Never catheterize the patient for the first time unless he has been seen by the house doctor.
13. Blood count (white blood corpuscles and differential) and urine examination on all postoperative patients having a temperature of 101°F. or over after second day.

OPERATING ROOM PREPARATIONS

1. Thoroughly scrub the part to be operated upon with sterile soap and water for at least fifteen minutes.
2. Wash with alcohol on sterile towel, twice.
3. Pat with ether on sterile towel, twice.
4. Paint with 3.5 per cent iodine solution.

BRAIN CASES

General:

1. Magnesium sulphate retention enemas oz. 4, once daily.
2. High glucose diet. Limit fluid intake to 500 or 800 c.c. daily.
3. Glucose rectal taps oz. vi of 5 per cent solution if dehydrated.
4. Sedative night before operation.
5. Caffeine sodium benzoate grains vii ss. hypodermically, twice or thrice daily.

Preoperative:

6. No food for eight hours preoperative.
7. Soap suds enema three hours preoperative.
8. Shave entire head.
9. Give no morphine unless directly ordered by attending physician. (If giving morphine, give with caffeine. Dose for dose, morphine grain ¼ with caffeine sodium benzoate grains vii ss.)

A suitable blood donor should be available throughout the operation in all cases.

Postoperative:

10. Elevate head of bed slightly (unless cerebellar). Wound down to pillow if drained.

* Submitted for publication November 12, 1930.

11. Keep warm with warmed blankets. Avoid draughts.

12. Two hundred fifty c.c. 25 per cent glucose solution (intravenously) on return to bed and daily for three days.

13. Rectal taps of 5 per cent glucose oz. vi every four hours while indicated, if dehydrated.

14. Pulse and respiration every fifteen minutes for six hours, thereafter every four hours.

15. Blood pressure every hour for six hours, thereafter every four hours.

16. Rectal temperature every four hours.

17. Call house physician, if pulse rises 20 points or falls below 60.

18. Catheterize after eighteen hours only s. o. s. if ordered by doctor.

19. Soap suds enema on second day and thereafter p. r. n.

20. Diet first day 1 quart liquids with glucose (fruit juices). Second day 2 quarts liquid with glucose (fruit juices). Third day fluids ad lib. Thereafter increase to soft, etc.

21. Routine neurological examination first and third days postoperative and thereafter once a week.

22. Fundus examination by neurologist or oculist twice a week.

23. Dressing third to fourth day (remove sutures if indicated). Secondary operations not until fifth to seventh day.

24. Massage when feasible, starting fourth day.

SPINE CASES

General:

1. Particular care to skin to prevent bed sores.

2. No hot water bags, hot pads, poultices or lighted cradles.

3. For urinary retention: express urine. Catheterize if necessary.

4. For fecal incontinence: high colonic irrigation daily.

5. Prevent contractures by postural changes.

6. Glucose rectal taps 5 per cent solution oz. vi every four hours, if dehydrated.

7. Air mattress.

Preoperative:

8. Shave back widely, above, below and to sides.

Include back of head to occiput for cervical cases.

Include region about arms for lumbar cases.

9. Nothing to eat for eight hours preoperative.

10. Soap suds enema three hours preoperative. If this gives no results follow by high colonic irrigation.

Postoperative:

11. Air mattress, bed flat.

12. Intravenous normal saline or glucose on return to bed (500 c.c.).

13. Rectal taps 5 per cent glucose oz. vi every four hours while needed.

14. Keep warm with warmed blankets. Prevent draughts.

15. Pulse and respiration every fifteen minutes for six hours, thereafter every four hours.

16. Blood pressure every hour for six hours. Thereafter every four hours.

17. Notify house surgeon if pulse rises 20 points or falls below 60.

18. Notify house surgeon if temperature rises above 101°F.

19. Rectal temperature every four hours.

20. Keep patient comfortable and *dry*.

21. Turn hemilaminectomies every three hours. Turn as a whole.

22. Turn bilateral laminectomies only after twenty-four hours.

23. Catheterize after eighteen hours only by doctor's orders.

24. *Diet*. First seventy-two hours only hot liquids, thereafter ad lib.

25. High colonic irrigations for gas pains.

26. Massage limbs on fourth day. Thereafter, three times weekly.

27. For reduction of contracture exercise (even in bed) starting seventh day.

28. Soap suds enema on second day, and thereafter p. r. n.

29. Neurological examination on first and second days and twice weekly thereafter.

TRIGEMINALS

General:

1. High glucose diet. Soft, semi-soft, or fluid.
2. Glucose rectal taps 5 per cent solution oz. vi every four hours, if dehydrated.
3. Sedative night before operation.
4. Digitalize if necessary.

Preoperative:

5. Nothing by mouth for eight hours preoperative.
6. Soap suds enema three hours, preoperative.
7. When called to operating room, if general anesthetic is to be used, give atropine grains $\frac{1}{150}$ and morphine grains $\frac{1}{4}$ by hypodermic. If local anesthetic, morphine sulphate grains $\frac{1}{4}$ and hyoscine grains $\frac{1}{150}$.
8. Shave only one side of head.

Postoperative:

9. Eye shield over eye until corneal sensation has been established.
10. Elevate head of bed slightly.
11. Wound toward pillow, if drained.
12. Keep warm with warmed blankets. Avoid draughts.
13. Rectal taps of 5 per cent glucose oz. vi every four hours.
14. Pulse and respiration every fifteen minutes for six hours; thereafter hourly.
15. Blood pressure every hour for six hours; thereafter daily.
16. Rectal temperature every four hours.
17. Soap suds enema on second day and thereafter p. r. n.
18. Diet ad lib. Fluids first day; soft second day, etc.
19. Care of eye:
    a. Eye shield.
    b. Irrigate with boric acid solution every six hours.
    c. Yellow oxide of mercury to lids.
    d. 20 per cent argyrol gtts. ii into eyes if inflamed.
    e. Notify doctor if inflamed or secreting pus.
20. Neurological examination:
    a. Area anesthesia
    b. Corneal reflexes
    c. Motor power
    d. Cranial palsies
    } weekly
21. Dressing on second, fifth and eighth days.

    Sutures out (if not subcuticular) on second day.

PERIPHERAL NERVE CASES

General:

1. Particular care of trophic sores.
2. Prevent edema by raising limb.
3. Prevent contractures by position of limb.
4. Do not use hot water bags, poultices or lighted cradles.

Preoperative:

5. Shave limb widely.
6. No food for eight hours preoperative.
7. Soap suds enema three hours preoperative.
8. When called to operating room for general anesthetic, give atropine grains $\frac{1}{150}$ hypodermically. For local anesthetic, give morphine grains $\frac{1}{4}$ and hyoscine grains $\frac{1}{150}$ hypodermically.

Postoperative:

9. Keep warm and free from draughts.
10. Rectal taps 5 per cent glucose solution if needed.
11. Pulse and respiration every hour for six hours; thereafter every four hours.
12. Blood pressure every hour for six hours. Thereafter every four hours.
13. Rectal temperature every four hours.
14. Move patient to keep him comfortable.
15. Keep operated limb quiet and warm. Immobilize limb if ordered.
16. Elevate distal part to improve venous blood return.
17. Watch for oozing. Call house surgeon if pulse rises 20 points.
18. Watch limb distal to bandage. Notify house surgeon if it becomes blue, cyanotic or edematous.

19. *Diet* first day, fluids ad lib.
Second day, soft diet.
Third day, regular diet.

20. Soap suds enema on second day, thereafter p. r. n. twice.

21. House surgeon to examine part distal to bandage daily.

22. Routine neurological examination weekly.

23. Dressing with removal of sutures fifth to tenth day.

24. Massage and galvanism on removal of splint.

25. Diathermy for painful sore.

In addition, the following routine is advisable for the reduction of increased intracranial pressure.

(1) Lumbar puncture.

(2) Hypertonic glucose by vein (100 c.c. of 50 per cent solution three times daily).

(3) Caffeine sodium benzoate grains VII ss. every four hours (hypodermically).

(4) Rectal taps of 25 per cent glucose 4 oz. every four hours.

(5) Elevate head of bed 15 to 45°.
Skull trephine with ventricular puncture in posterior fossa and third ventricle tumors.
If these measures prove inadequate,

(6) Right subtemporal decompression in comatose cases with marked papilledema that do not react to the previous procedures within two or three hours.

In conclusion, we have never regretted the inflexible rule in dealing with these cases, that both the neurological physician and the neurological surgeon *must* agree on the need for operation, before such operation be undertaken.

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* Continued from p. 95.

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EDITORIAL

BOOTLEG SURGEONS

A NEW breed of "cutter" has sprung up in various parts of the country. They are discovered in the poorer sections of densely populated communities. They are graduates of medical schools. They are licensed to practice medicine and surgery by the state in which they reside.

These vermin are without a semblance of surgical training. Many of them cannot boast of a six months' internship in a fourth rate hospital. Often they graduated from medical school within the past five years. They possess real insight into the psychology of human beings, have a thick crust, both mentally and spiritually, never did have a conscience, but their bump of business acumen is developed to the *n*th degree.

They open an office and personally call upon the general practitioners in their vicinity. They talk business from the start. The bootleg surgeon promises to use the practitioner when he can, for which he will be paid, and in return the general practitioner is to refer all his surgery to the "cutter" who will remit from 50 to 75 per cent of the fees charged. An equable arrangement for all parties. In no time the "carver" is doing a great volume of work. Needless to say all kinds of unnecessary surgery is done. The mortality is frightful. The morbidity never will be computed. But the patient always pays and pays. One of their favorite tricks is to give a hopeless prognosis. Should death follow their alibi is air-tight. If the

patient lives to leave the hospital or sanatarium the surgeon is a miracle worker.

Personally, we know several of this type. One of them not five years in practice already is independently rich. These surgical outcasts may be criticized but nothing can be done about it—not at the present, at least—except giving vent to indignation, as we are doing, for example.

The fault lies with our laws. One passes a state board examination and is launched forth to do surgery or medicine in any or all its branches. No previous experience is necessary.

It is hurting the medical profession. It is unfair to the public. It is unfair to the young man who spends from two to five years as an interne or hospital resident to prepare himself for his calling.

Talk will get us nowhere. The laws need changing. Some of our medical practice acts need revising and long, sharp teeth added and then used.

T. S. W.

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CORRESPONDENCE

To the Editor:

The case of a patient ninety-three years of age, in whom union of a medial fracture at the hip was attained by the abduction treatment, to which you have called my attention, suggests to me, that your readers may be interested in a summary of a recent analysis of the treatment of the same type of fractures at the Massachusetts General Hospital by the same method.

According to Dr. Reggio the cases received at this hospital were the most unfavorable class. Yet in 70 per cent of the number (49 of 70) the abduction treatment was applied and in 66 per cent of the cases, in which it was carried to a conclusion, union was attained.

This percentage of repair presents a striking contrast to the results under the old system, as may be illustrated by recent statistics.[1] In 1928 Katzenstein reported to the Surgical Society of Berlin on 169 cases of transcervical fracture treated by conventional methods. Good results were attained in 11.5 per cent, a percentage which, according to Axhausen who discussed the paper, might be accepted as representing the general experience.[2]

During the present year Hübner has reported on 136 fractures treated at the Charity Hospital of Berlin. Bony union was attained in but 6 per cent and passable function in 17 per cent of the cases.[3] It may be noted incidentally that there is on record a report by Scudder on the final results of a group of 16 cases treated at the Massachusetts General Hospital in pre-abduction days. Of these it is stated, that in but two instances was there useful function.

The treatment of this fracture must be adapted to the patient as well as to the injury and from this standpoint Dr. Reggio's report is distinctly disappointing, since the death rate was 26.5 per cent, or far higher than the average. It appears, however, that 9 of the 13 deaths (69 per cent) were in patients over seventy years of age, and that 7 might be classed as accidental or unusual, 1 from anesthesia, 5 from embolism and 1 from cerebral hemorrhage.

In a far larger number of cases of the same type treated by the same method reported by Löfberg the death rate was but 6 per cent.[1] In a group of 77 cases treated by the staff of the Hospital for Ruptured and Crippled there were 5 deaths: one of pneumonia in a woman of eighty-eight, 1 of senile dementia in a woman of seventy-eight four months later, 1 of advanced myocarditis and 2 from embolism.

At a recent symposium on the treatment of medial fractures, Anschütz of Kiel expressed the opinion "that any other treatment than by the abduction method was irrational and absurd." Mosenthal of Berlin said that there could be no discussion of the relative merits of a treatment that had, according to published statistics, raised the percentage of bony union to 75 per cent and in his own practice to 90 per cent of the cases. He concluded that the real obstacle to its general adoption was inability to meet its requirements.[2]

According to Hey Groves[3] there are but two methods worth consideration, the abduction treatment and open operation.

These conclusions refer only to medial fractures, in which the question is of direct repair, but they apply equally to those at the base since the abduction method is the only effective means of reducing resistant deformity, the essential preliminary of normal function which in the past has received no consideration whatever.

The question at issue is of standard, whether it shall be positive or negative. What, in anticipation, may be termed the

[1] Reggio, A. W. *J. Bone & Joint Surg.*, 12: 819–826, 1930.
[2] *Zentralb. f. Chir.*, 55: 322–327, 1928.
[3] *Arch. f. Orthop.*, May 1930.

[1] *Zentralb. f. Chir.*, 54: 2184–88, 1927.
[2] *Med. Klin.*, 25: 463, 1929.
[3] *J. Bone & Joint Surg.*, 12: 1–11, 1930.

old teaching is based on the assumption that the result is practically determined by the character of the injury and that positive intervention is essentially hazardous and futile. The typical patient presented to the student is aged and infirm and the characteristic fracture that which is least capable of repair.

The abduction treatment is the exponent of radical reform, simply because it is in accord with the standard that governs the treatment of all other fractures. It is, therefore, primarily concerned with that neglected and submerged class, in which the treatment of the fracture is manifestly practicable.

This class is represented by the 120 cases of ununited fracture reported by Henderson[1] of the Mayo Clinic but 5 of which were in patients more than seventy years of age. Of 170 cases recorded at the Hospital for Ruptured and Crippled but 15 per cent were in patients over seventy. Only 52 were seen within a week after the injury. The remainder represented inefficient treatment and neglect.

When it is officially conceded, that fracture of the neck of the femur is amenable to the rules that govern the treatment of other fractures, and entitled, therefore, to the same moral and legal protection from incompetence and neglect, there can be, in a comprehensive sense, no alternative to the abduction method as a basic routine, and those who have trained in its application will find little occasion for substitutes.

Very truly yours,
ROYAL WHITMAN

To the Editor:

In the March number of the AMERICAN JOURNAL OF SURGERY my attention was called to a paper on spinal anesthesia by Dr. Meyer Saklad. Amongst others he refers to a criticism of the Pitkin method which I wrote and which appeared in the *Lancet* in January, 1930. He draws conclusions from that criticism which I had not drawn and did not intend should be drawn. It is notoriously difficult to say what one means and it is obvious that I have failed to do so in this case. With your permission I will endeavor to set the matter right. Dr. Saklad divides spinal anesthetists into two categories, those who think a fall in blood pressure is of little or no consequence and those who think that it is a serious matter. He puts me in the former category. But I refuse to be so limited. It is a question of the patient and the circumstances. That an enormous fall of blood pressure even up to 75 per cent does not matter in the vast majority of cases is obvious from the fact that the vast majority of patients who have this fall recover. So though we may state it as a rule to which there are but few exceptions that a fall in blood pressure due to spinal anesthesia itself can be regarded with equanimity (provided the Trendelenburg position be used) yet the few exceptions are important. There is the patient with narrowed coronary arteries who needs all his blood pressure to force the blood to his heart wall. He will die if his blood pressure is lowered. He will die soon of course in any case. Then there is the patient whose blood pressure has been lowered 50 per cent by spinal anesthesia and the operation (extensive manipulations intra-abdominal) produces shock, because stimulating nerves (the vagus) not affected by the anesthetic. The blood pressure goes still lower and the patient may die of heart failure. Though the special anesthesia has not caused the death it has prepared the way for it. It is easy as a rule to prevent such a death if you are on the qui vive and if you can get an intravenous saline injection given *at once*.

Secondly, Dr. Saklad says that Donald and I conclude that the use of this viscid solution of lighter specific gravity than spinal fluid is no more controllable than novocaine or neocaine crystals dissolved in spinal fluid and used as the anesthetic agent. I have drawn no such conclusion. I agree with Drs. Donald and Saklad that it is not as controllable as Pitkin

[1] *Surg. Gynec. Obst.*, Feb., 1920.

leads us to suppose. Seeing that the height of and duration of anesthesia are dependent on so many factors such as the dose, the height and weight of the patient, whether he is very ill or not, the force with which the injection is given, anatomical differences and absolute controllability are somewhat illusive. It is difficult for one individual to have a large experience of different methods and I have very little experience of non-viscid solutions. I am relying on the opinion of Profs. Forgue and Basset who have had twenty years' experience with them. Now they say they get vomiting about the twentieth minute so often as to be the rule. "A cette dose minima, l'agent chimique excite surtout le centre du vomissement: de là, ces nausées, cette poussée de vomissements de la vingtième minute, qu'il est classique . . . " Also they never use more than 120 mg. Now with the viscid solution vomiting except that due to visceral manipulation is rare. This means that the viscid solution does not diffuse, does not excite the vomiting center, is therefore more controllable. For a high abdominal operation I never use less than 250 mg. that is double the dose recommended by Profs. Forgue and Basset. It is the viscidity which makes this much larger dose possible, it slows the absorption and the excretion and so gives us a much longer time, roughly twice as long (ninety minutes as against forty-five given by Profs. Forgue and Basset as their average). Again, Profs. Forgue and Basset quote with approval the sixth observation of Pitres and Abadie which is to the effect that in an area of full anesthesia islands occur in which the analgesic has taken no effect. This has never happened in my experience with the viscid solution. So in these three particulars, the absence of widespread diffusion, the increase in the length of time and the regularity in the disposition of the anesthetic the viscid solution is more under control than the mobile.

Thirdly, Dr. Saklad says, "Both Donald and Hill reach the conclusion after a study of ephedrine that it does not prevent a fall of blood pressure." I am still using it and in 100 mg. doses so I presume I have some reason for so doing. I am of opinion that it frequently has an effect in keeping the blood pressure steady but many times the blood pressure falls heavily in spite of ephedrine. As an example: On Saturday last, April 18, a man aged sixty-seven suffering from gangrenous appendicitis and general peritonitis, had a blood pressure of 140 before operation. I gave him 100 mg. of ephedrine followed by 270 mg. of novocaine contained in 2.7 c.c. of duracaine. Fifteen minutes later his blood pressure was 60 and ten minutes later still it had gone to 50 mm. Hg. The next day a man aged thirty-two with a kidney affected with tubercle was treated in exactly the same way as far as the anesthetic was concerned. He was given 100 mg. of ephedrine followed by 270 mg. of novocaine in 2.7 c.c. of duracain. His blood pressure before the operation was 110, at the end of the operation one and one-half hours later his blood pressure was 140 and in the meantime had always been between these two figures. The operation was so long partly on account of the size of the kidney which weighed 27 oz., 765 gm., and partly due to the fact that the ureter was dissected out anteriorly and divided by the cautery. The anesthesia in both cases was completely successful in the sense that it was neither too high nor too low and neither patient wished to be made unconscious and both are making good recoveries. Whatever effect ephedrine may have over the fall of blood pressure due to the anesthetic it appears to have little or none in preventing the fall which sometimes occurs later due to shock caused by intra-abdominal manipulations. This latter may be entirely replaced by a rise to normal by an intravenous saline 1½ l. together with an intramuscular injection of pitressin. Pitressin is to be preferred to adrenalin in these cases.

E. Falkner Hill

NICHOLAS SENN

[1844-1908]

The American Journal of Surgery
N. S. Vol. XIII, July, 1931

"SENN'S TEST"

NICHOLAS SENN was born in Buchs, Canton of St. Gall, Switzerland, October 31, 1844. He was brought by his parents to the United States in 1852. They settled in the town of Ashford, Wisconsin. He graduated from the Fond du Lac High School, Wisconsin, 1864, taught school for two years and at the same time read medicine with Dr. Munk. In 1868 he graduated from the Chicago Medical College with the degree of M.D. After an interneship of eighteen months in Cook County Hospital he moved to Elmore, Wisconsin, and began the practice of medicine. In 1874 he moved to Milwaukee but three years later went to Germany to study, returning in 1880, at which time he was called to be professor of surgery in the College of Physicians and Surgeons, Chicago. In 1884 he was made professor of the principles and practice of surgery at the same college. In 1888 he became professor of surgery and surgical pathology in Rush Medical College and in 1891 at Rush succeeded Charles T. Parkes in the chair of practice of surgery and clinical surgery. In addition he was professor of surgery in the Chicago Polyclinic. He was chief surgeon to several hospitals.

Early in his career he did much research work in abdominal surgery. He was a leader in this field. In his researches in intestinal perforation, especially in gunshot wounds, he introduced hydrogen gas into the rectum; then a light was held near the coils of intestines and in this way the point of perforation discovered by the igniting gas (Senn's test). Senn also employed plates of decalcified bone in intestinal anastomosis. He is responsible for much of our modern ideas of surgical tuberculosis. In 1885 he published an excellent book on "Surgery of the Pancreas." He was a rapid and voluminous writer. He wrote at all times, seldom using reference works. This resulted in loose, slipshod work and although he is credited with 160 volumes, few had more than a short life.

Senn was the first in the West to conduct experiments on animals and report his conclusions. In 1896 he delivered the surgical oration, and in 1897 was president of the American Medical Association. He saw service in the Spanish American War. He gave wonderful books, especially of the older writers, to the Newberry Library. He endowed the Senn room in St. Joseph's Hospital (Chicago) where he was confined in his last illness. To Rush Medical College he gave a clinical building at an approximate cost of $100,000.

Senn was a pioneer pathologist in this country and brought it into practical application with his surgery.

He was short, thick set, nervous, untiring, simple minded, sympathetic. He founded no school; neither did he train younger men to carry on from where he left off. He was jealous of competition.

In his later years he was widely travelled and wrote of what he saw and experienced. On what was to be his last trip he climbed a mountain 16,000 feet high which was responsible for a cardiac dilatation. Returned home he rapidly grew worse, entered a hospital and died, leaving a widow and two sons, both physicians, at the age of sixty-four years, on January 2, 1908.

T. S. W.

[From Fernelius' Universa Medicina, Geneva, 1679.]

BOOKSHELF BROWSING

THE "BYRTH OF MANKYNDE"*

THE 1540 EDITION

CHARLES A. GORDON, M.D., F.A.C.S.

BROOKLYN, N. Y.

IN the library of the Medical Society of the County of Kings, of Kings County, Brooklyn, New York, is a perfect copy of Richard Jonas' "Bryth of Mankynde" imprinted at London by T. R. in 1540. This, the first edition of the first book on obstetrics printed in English is commonly referred to as Raynalde's "Byrth of Mankynde."

It is a translation of "De partu hominis et quae circa ipsum accidunt, Libellus D. Eucharii Rhodionis, Medici," the Latin edition of "Der Schwangern Frawwen und Hebammen Rosengarten," by Eucharius Rösslin, which was first printed at Strassburg in 1513, and translated into Latin in 1532, first at Frankfort.

Certainly the most interesting book on obstetrics in English, this edition is extremely rare and of great interest as the very beginning of all our obstetric literature. Though J. H. Aveling in 1875 discovered in the British Museum a manuscript of the fifteenth century, "vellum in quarto, beautifully written and illuminated, two hundred thirty-four pages of which are devoted to Midwifery and the Diseases of Women," it had never been printed and never became popular like the "Byrth of Mankynde," which was printed again in 1545, and ran through one edition after another until 1654. For over a hundred years the only textbook in English, it was frequently revised without the addition of much of importance.

It is not my intention to describe the "Byrth of Mankynde" minutely, as that was brilliantly done by J. W. Ballantyne of Edinburgh in 1906. He, however, never saw a perfect first edition, as the British Museum copy, the only one to which he had access was "imperfect, consisting of but 84 numbered leaves instead of 86 in Herbert's [Heber's] copy, and it lacks the plates." A copy in the library of the Obstetrical Society of London and another in the library of the University of Glasgow, said to be 1540 editions, were rejected by him.

Heber's copy described by Dibdin in 1816 as perfect, "had 86 numbered leaves, quarto, stout paper, fine large Gothic type." Ballantyne thought his description exceedingly valuable on account of the great rarity of this edition. Dibdin gave the table of contents, and noted the presence of "Cum privlegio Regali, ad imprimendum solum" at the bottom of the title-page. "Between folios XXIV and V are four copper plate engravings containing seven-

* Read at a meeting of the Brooklyn Gynecological Society, December 5, 1930.

teen illustrations of children in utero," he said. This copy cannot be traced.

Gustav Klein of Munich in 1910 showed that there were fifteen English editions of Raynalde's book from 1540 to 1654, two or three more than Ballantyne was able to find, but of the first, or Jonas edition, he was sure there never was another.

Klein had in his possession a manuscript in quarto with the title "The byrth of mankynde newly translated out of laten in to Englysshe." Fixing its date as not before 1535, and pointing out that no one would be likely to write out a book already in print, he concluded that his was the original manuscript. A treasure indeed.

Denman stated in 1794 that "Dr. Combe has in his possession the identical manuscript copy of this work, which was presented to Catherine, Queen of Henry the VIII. This copy is signed with the name of ——— Jonas, but it does not appear why the book was afterward published by Raynold in his own name." This manuscript in 1840 was in the possession of T. J. Pettigrew, who briefly described the 1540 edition "as of exceeding rarity."

Sir D'Arcy Power states that after the death of Mr. Pettigrew in 1865, it was sold at Sotheby's to a dealer, and passed, he believes, into the hands of Dr. Lloyd Roberts of Manchester. He does not, however, know its present whereabouts, and knew nothing of Klein's claim to ownership. Nor was Klein aware of the previous whereabouts of his manuscript, nor does he say that Jonas' signature appears therein. It seems that it should.

Further search for the manuscript has proved fruitless. Dr. Lloyd Roberts died in 1920. Mr. Wilson, Librarian of the Manchester Medical Society and University of Manchester, was not aware that Dr. Roberts possessed the manuscript, but feels sure that if he did, it would be found in the Library of the Royal College of Physicians, London. It is not there, however, nor is it in Manchester. Gustav Klein too is dead; the major portion of his library went to the University of Louvain. The manuscript was not offered to them, and possibly was sold separately. There is no doubt of its existence somewhere, yet it seems strange that a treasure like this could survive the centuries, appearing in 1794, 1840 and 1910, only to vanish again. The story of its wanderings has yet to be told.

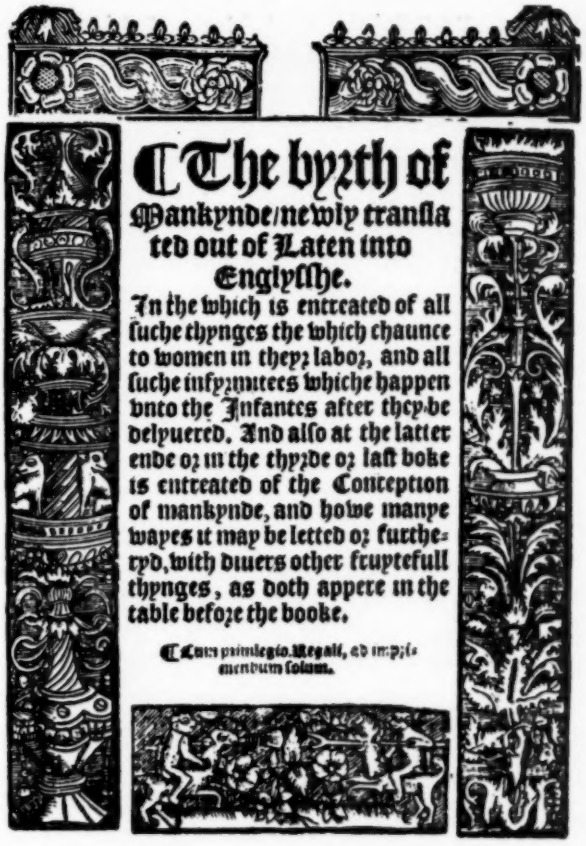
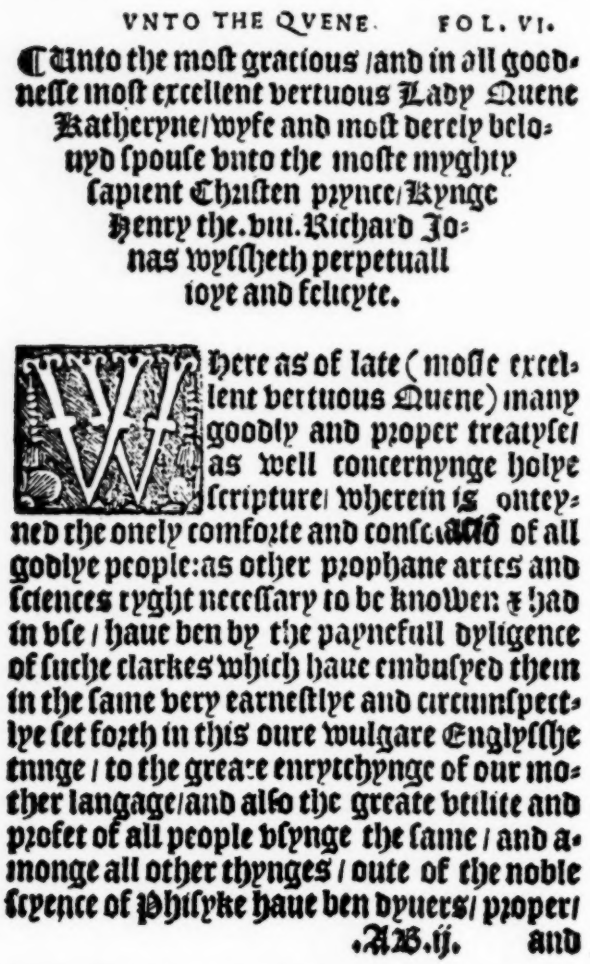

¶ The byrth of
Mankynde/newly transla
ted out of Laten into
Englysshe.
In the which is entreated of all
suche thynges the which chaunce
to women in theyr labor, and all
suche infyrmitees whiche happen
vnto the Infantes after they be
delyuered. And also at the latter
ende or in the thyrde or last boke
is entreated of the Conception
of mankynde, and howe manye
wayes it may be letted or further-
ryd, with diuers other fruytefull
thynges, as doth appere in the
table before the booke.
¶ Cum priuilegio Regali, ad imprimendum solum.

Fig. 1. Title-page 1540 edition.

The byrth of Mankynde / newly translated out of Laten into Englysche. In the which is entreated of all suche thynges the which chaunce to women in theyr labor and all suche infyrmitees whiche happen unto the Infantes after they be delyuered. And also at the latter ende or in the thyrde or last boke is entreated of the Concepcion of mankynde and howe manye wayes it may be letted or furtheryd, with divers other fruytefull thynges, as doth appere in the table before the booke.

Klein also knew nothing of a description of our first edition by George Jackson Fisher, from whom we obtained it. Fisher, an ardent bibliophile, described it in 1881 quite completely, but not quite correctly as he had no knowledge of the important facts later unearthed by Ballantyne.

Klein, however, claimed to have the only complete or perfect copy of the 1540 edition. "Mein Exemplar," he said "88



VNTO THE QVENE. FOL. VI.

¶ Unto the moſt gracious /and in all goodneſſe moſt excellent vertuous Lady Quene Katheryne/wyfe and moſt derely beloyd ſpouſe vnto the moſte myghty ſapient Chriſten pꝛynce/Kynge Henry the.viii.Richard Jonas wyſſheth perpetuall ioye and felicyte.

Where as of late (moſte excellent vertuous Quene) many goodly and pꝛoper treatyſe/ as well concernynge holye ſcripture/ wherein is onteyned the onely comforte and conſolacion of all godlye people: as other pꝛophane artes and ſciences ryght neceſſary to be knowen & had in vſe / haue ben by the paynefull dyligence of ſuche clarkes which haue embuſyed them in the ſame very earneſtlye and circumſpectlye ſet forth in this oure wulgare Englyſſhe tunge / to the greate enrychynge of our mother langage/and alſo the greate vtilite and pꝛofet of all people vſynge the ſame / and amonge all other thynges / oute of the noble ſcyence of Phiſyke haue ben dyuers/ pꝛoper/

.AB.ij. and

Fig. 2. Dedication, 1540 edition. Unto the Quene. Unto the most gracious / and in all goodnesse most excellent vertuous Lady Quene Katheryn / wyse and most derely beloyvd spouse unto the most mighty sapient Christen prynce / Kynge Henry the VIII Richard Jonas wyscheth perpetuall joye and felicyte.

Where as of late (most excellent vertuous Quene) many goodly and proper treatyses as well concerynge holye scripture / wherein is conteyned the onely comforte and consolatio of all godlye people: as other prophane artes and sciences ryght necessary to be knowen and had in use / have been by the paynefull dyligence of suche clarkes which have embusyed them in same very earnestlye and circumspectyle set forth in this oure wulgare Englysche tunge / to the great enryching of our mother language / and also the greate utilite and profet of all people usyng the same / and amonge all other thynges / oute of the noble scyence of Phisyke have been dyuers / proper /.

numerierte blätter hat und die Kupfertafeln enthalt; somit wäre mein Exemplar das einige bis jetzt bekannte vollständige Exemplar der Englischen Aufgabe von 1540."

It is my purpose to acquaint bibliophiles with the existence of another copy of this book.

For centuries authorship was erroneously attributed to Thomas Raynalde, a London physician, the T. R. in the colophon being held to mean him. Strange to say this idea was often referred to authoritatively. Ames and Dibdin who had seen the first edition, had failed to construe properly the dedication of the first edition by Richard Jonas in the light of the prologue of the second edition where Thomas Raynalde refers to:

> . . . a certayne studious and diligent clarke at the request and desyre of divers honest and sad matrones, beynge of hys acquayntaunce, dyd translate out of Latin into English a great part of thys boke, entiteling it according to the Latine inscription (de partu hominis, that is to saye: of the byrth of mankynd) which we nowe do name (The womans boke) (for so moch as the most parte or well neare all therein entreated of, doth concerne and touche onely women). In whych his translation he varied, or declyned nothing at al from the steppes of his Latine auctor. Obseruynge more fydelyte in translatynge and alowyng many thynges in the same Boke, greatly neadyng admonityon and wary aduyse or counsell to the readers, whyche otherwyse myghte sometymes use that for a helpe, thee which shoulde turne to a hynderaunce, wherefore I reuoluying and earnestly reuysinge from top to toe sayd boke, and here withal considering the manifold utilite and profyte, which thereby moughts ensue to all women [as touching that purpose] yf it were more narrowly loked over, and wyth a strayghter iudgement more exactly every thing therein pondred and tryed, thoughte my labour and paynes should not be euyl employed, ne unthankefully accepted and receaued of al honest, discrete and sage women. If I after good and dylygent perusing thereof dyd correcte and amende soche fautes in it, as seemed worthy of the same, and to aduyse the readers what thynges were good or intollerable to be used, which were daungerous, and which were utterly to be eschued. The which thinge I have not only so done, but over this have

thereunto adioyned and annexed dyuers more experimented and more familier medicines.

By a strange coincidence there lived in London at the same time, two Thomas Raynaldes, the one a printer, at the Signe of the Star in St. Paul's Churchyard, the other a physician who practiced in London and Paris, and who may have been a relative of the printer. Richard Jonas, about whom nothing more is known, was the studious and diligent clarke referred to by the editor of the second edition, as the translator of the first. These facts seem to have been clearly established by the brilliant researches of Ballantyne who admits that "It is just possible that Thomas Raynalde may have been the maker of the translation of 1540, and that he took the *nom de plume* of Richard Jonas to save himself from the possible obloquy to the physician who concerned himself [in those times] with the subject of midwifery."*

The work is still called Raynalde's "Byrth of Mankynde," and has been for almost four hundred years, although the author of the first edition was Richard Jonas. Fisher was not deceived, nor was Robert Bland, but others were, until the question was definitely settled by Ballantyne. The first edition was revised "from top to toe" in 1545 by Thomas Raynalde, who added the prologue and other material. "He may have edited the third edition in 1552 and the fourth in 1560, but subsequent editions were almost identical, and probably Thomas Raynalde, the physician, had no hand in them."

THE 1540 EDITION

Our beautiful copy is in fine condition, bound in old red leather, and the finest specimen of black letter I have ever seen. The paper is strong, clear and hardly yellowed with age. Gothic was introduced into England by Caxton, who brought the art of printing there in 1457, and was employed extensively in a great many of the earliest presses all over Europe. It is now called lettre de forme, black letter, or English in English speaking countries.

Within its covers are the bookplates of Russell Plumptre and Robert Bland, and a note signed R. B. (Robert Bland) is carefully written.

This book was bought at Leigh & Sothebye, March 20, 1794, out of the library of Dr. Russell Plumbtre, many years Regius Professor of Physick in the University of Cambridge who lived to a very advanced age. I believe more than 90 years of age.* It is a translation of Eucharius Rhodion, De Partu Hominis, published originally in German, and first translated into Latin and printed at Frankfort in the year 1532 . . . But of the present translation which is exceedingly scarce, there never was another edition. R:B:

Plumptre filled the chair of Physick at Cambridge for more than half a century, dying in 1793, aged eighty-four. I have been able to find no record of his writings.

Robert Bland, however, a well known obstetrician who died in London in 1816, aged seventy-six, was the author of—

1. Some Calculations of the Number of Accidents or Deaths which happen from Parturition. 4to. Lond. 1781.

2. Observations on Human and Comparative Parturition. 8vo. Lond. 1794.

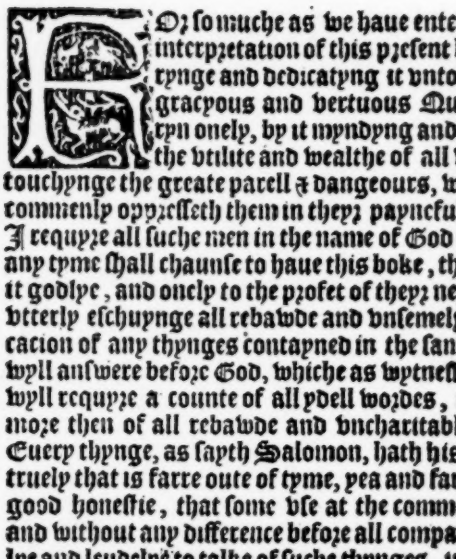
3. Proverbs, chiefly taken from the Adagia of Erasmus, with Explanations; and illustrated by Examples from the Spanish, Italian, French and English languages. 2 vols. 12mo. Lond. 1814.

The book is a small quarto containing 88 leaves or 175 unnumbered pages. The type matter on the back of folio 85 and folio 87 is transposed, through printer's error. The text on the back of folio 87 should be on the back of folio 85, and vice versa. This is exactly as in Klein's copy,

* Sir Wm. Osler in Bibliotheca Osleriana, Bibliotheca Secunda under item 3821 (Oxford, at the Clarendon Press, 1929) says: "Mr. W. H. Buckler, in a personal communication (1924), suggests that Dr. Raynalde, the editor, may have been a Thos. Raynolde of Merton College (B.A., 1518: Fellow, 1520) who, through the influence of John Chambre, physician to Henry VIII, became chaplain to Queen Jane Seymour. This connexion and the fact that he visited Paris both have some significance (cf. Ballantyne, pp. 304–6). He should not be confused with Thos. Raynoldes, or Reynolds, B.A. in 1522, Fellow of Merton in 1526 and later Warden."

* Dr. Russell Plumptre, was born 1709, died 1793.

for Klein says, "Blatt 85 *verso* and 87 *verso* sind imsatz verwechselt." There are three Bokes, firste, seconde and thirde.



VNTO THE REDER

¶ An admonicion to the reader.

For ſo muche as we haue enterpꝛyſed the interpꝛetation of this pꝛeſent boke, offerynge and dedicatyng it vnto our moſte gracyous and vertuous Quene Katheryn onely, by it myndyng and tenderyng the vtilite and wealthe of all women, as touchynge the greate parell & dangeours, which moſte commenly oppꝛeſſeth them in theyꝛ paynefull labours. I requyꝛe all ſuche men in the name of God, whiche at any tyme ſhall chaunſe to haue this boke, that they vſe it godlye, and onely to the pꝛofet of theyꝛ neyghbours, vtterly eſchuynge all rebawde and vnſemely communi cacion of any thynges contayned in the ſame, as they wyll anſwere beforꝛe God, whiche as wytneſſeth Chꝛiſt, wyll requyꝛe a counte of all ydell woꝛdes, and muche moꝛe then of all rebawde and vncharitable woꝛdes. Euery thynge, as ſayth Salomon, hath his tyme, and truely that is farre oute of tyme, yea and farre from all good honeſtie, that ſome vſe at the commune tables and without any difference beforꝛe all companyes rudelye and leudelyē to talke of ſuche thynges, in the which they ought rather to knowe muche, and to ſaye lyttell, but only where it maye do good, magnifyeng the myghtye God of nature in all his woꝛkes, compaſſionatynge and pytyenge oure euen Chꝛiſtians, the women whiche ſuſtayne and endure foꝛ the tyme ſo greate doloꝛ and payne foꝛ the byꝛth of mankynde and delyue- raunce of the ſame in to the woꝛlde.

Pꝛayſe God in all his woꝛkes.

FIG. 3. Unto the Reder.

An admonicion to the reader. For so muche as we have enterprysed the interpretation of this present boke, offerynge and dedicatyng it unto our moste gracyous and vertuous Quene Katheryn onely, by it mynding and tenderyng the utilite and wealthe of all women, as touchynge the greate parell and dangeours, which moste commenly oppreseth them in theyr paynefull labours, I requyre all such men in the name of God, whiche at any tyme shall chaunse to have this boke, that they use it godlye, and onely to the profet of theyr neyghbours, utterly eschewing all rebawde and unsemely communication of any thynges contayned in the same, as they will answere before God, whiche as wytnesseth Christ, will requyre a counte of all ydell wordes, and much more then of all rebawde and uncharitable wordes. Everythynge, as sayth Salamon, has his tyme, and truly that is farre oute of tyme, yea and farre from all good honestie, that some use at the commune tables and without any difference before all companyes rudelye and leudelye to talk of suche thynges, in the which they ought rather to knowe muche, and to saye lyttell, but only where it maye do good, magnifyeng the myghtye God of nature in all his workes, compassionatynge and pytenge oure even Christians, the women whyche sustayne and endure for the tyme so greate dolor and payne for the byrth of Mankynde and delyverance of the same in to the worlde. Prayse God in all his workes.

The plates however are between folios xxiv and xxv, not between folios xx and xxi as in Klein's copy. They are between 13 and 14 of the text description which is apparently their natural place. These plates are sewed in with a strong thread, in the same way and with the same thread that stitching is done in other parts of the book. A "Rosengarten" of 1528, and a "De Partu Hominis" of 1554, also in our possession, are sewed in the same manner with the same kind of thread. In every particular, save the location of the plates our edition collates perfectly with Klein's description.

Sir D'Arcy Power locates the plates as between folios xxxiv and xxxv. He has since corrected this to folios xxiv and xxv, agreeing with Dibdin's description of the British Museum specimen, and our copy. He is the first to state that there were two issues in 1540, one with "Cum privlegio Regali, ad imprimendum solum" on the title-page, the other without this privilege. It has been repeatedly stated that there was but one edition, and this is probably the fact. Power himself suggests that the printer after selling a number of copies issued the remainder with a new or altered title-page. The text was not reset since peculiarities in type and printer's errors are identical in the two issues, once the property of Dr. Lloyd Roberts and now in the possession of the Royal College of Physicians, London; one copy is not complete, however, lacking the birth figures.

The title page, [Power says] is of extreme interest. The ornament consists of four separate panels. The two side ones are not similar, that on the dexter side contains two small animals, that on the sinister side is a floral decoration ending in a burning censer. The lower panel represents a duel of monkeys, armed with a broom and a pitchfork, mounted on lambs. The real interest of the title page lies in the top panel. It consists of a rose and cable ornament with an empty shield in the center.

Our copy, as well as Klein's, has the privilege and title-page as he describes. In a comparison of the ornamental initial letters which he has worked out as a means of identifying various editions, our copy collates perfectly with his description. The upside down "1" initial letter is an interesting example of the printer's troubles with the wood block. The "w" is said by Power to be a beautiful specimen of wood cutting.

THE "BYRTHE FYGURES"

There are four copper plate engravings on two pages, showing in all XVII illustrations of the fetus in utero, and the woman's stool. These are the famous "byrthe fygures" which appeared first as woodcuts in the German and Latin editions, themselves the earliest obstetrical figures printed from wooden blocks.

Martin Flack, Jr., the printer of Rösslin's book, had them cut by the famous woodcutter, Erhard Schön in 1513. Manuscripts found in Paris, Rome, Dresden, Copenhagen and Munich all show 15 to 16 positions of the fetus. Curious and purley imaginative as they are, it is interesting to note that a few years before, Leonardo da Vinci had sketched the fetus from post-mortem observation of the opened uterus.

These copper plate impressions were made with a roller or a rolling press, and are of great interest typographically as, with one possible exception, the frontispiece to Galenus' "De Temperamentis," printed at Cambridge in 1521, they were the very first copper plate impressions seen in England. It is not known whether they were cut in England or not, but they probably were, as they do not compare at all favorably with other work of that period in Europe, where the greatest geniuses, as soon as the art of printing was spread abroad, threw themselves whole heartedly into the perfection of the new art. The great masters of design, who had earned fame by their work in cutting wood, soon found that engraving upon copper was much easier, with happier effects in anatomic illustration at least; the old art suffered, and the new became more perfect.

BOKE. FOL. LXXXVIII.

declared / Whiche for breuite and shortenesse
We for this tyme do let passe / makynge here
an ende of this treatyse / the whiche We
haue composed and translated
oute of Laten / to the ho-
nour of God / the uti-
lite and profette of
all honeste ma-
trones.

Deo gratias.

Imprynted at London
by. T.R.

Anno Domini. M. CCCCC. XL.

FIG. 4. Last folio. Colphon. Declared / which for brevite and shortnesse we for this tyme do let passe / makynge here an ende of this treatyse / the which we have composed and translated oute of Laten / to the honour of God / the utilite and profette of all honeste matrones. Deo gratias.

Imprynted at London by T. R. Anno Domini M, MCCCCCXL.

Printing however was in a deplorable condition in England at the end of the 15th century. The best evidence of this was the enactment of a law in 1483,

> . . . by which any artificer, or merchant stranger of what nation or country he be of, was not to be hindred from bringing into this realm, or selling by retail or otherwise any books written or printed . . . which he hath, or shall have, to sell by way of merchandise—or from their dwelling within this said realm for the exercise of the said occupation.

The plates of the first edition up to now never have been reproduced. Dibdin's reproduction in 1810 was "printed from a wooden block for the convenience of press work," and he copied but five of the "byrth fygures," VIII to XII.

These famous figures were not original with Rösslin. There is no doubt of that. Manuscripts all over Europe contained a

great many illustrations, from which pictures in the early printed books were freely borrowed. These came almost certainly from Moschion's or Muscio's Latin "Catechismus for Midwives," and were taken by him from Soranos. In a scholarly discussion of the "Rosengarten," Ingerslev points out an analogy between Moschion's version of Soranos with Rösslin's text, and shows that the illustrated "Codex Palatinus" containing 16 illustrations of positions of the fetus was in Heidelberg close by, when Rösslin's book was published. Soranos, the first to draw the uterus, compared it to a cupping glass.

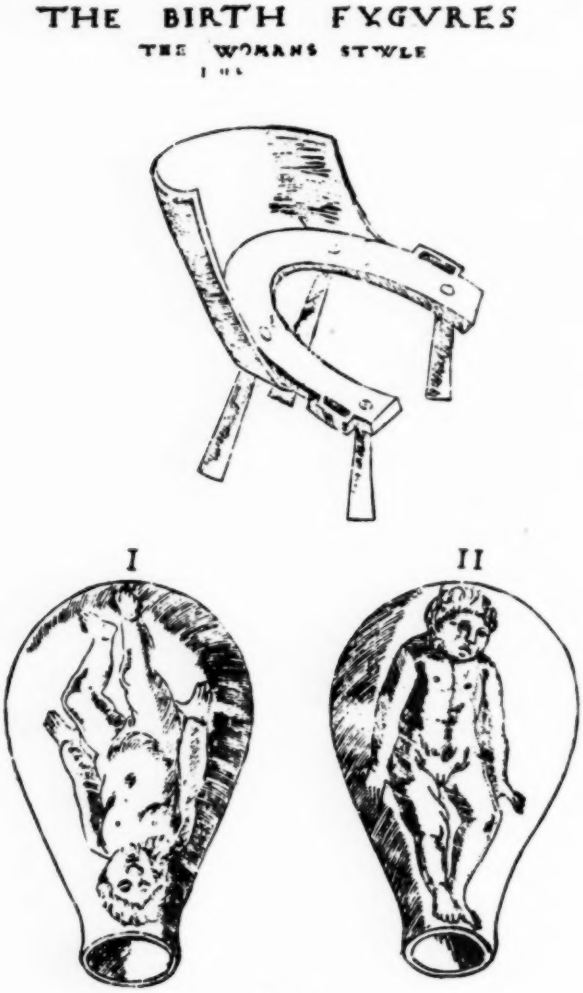


Fig. 5.

Who Muscio was is not quite clear, or when he lived, but probably in the sixth century; his manuscripts were widely distributed, and it is definitely known since the epoch making discovery of the original work of Soranos in 1838 by Fr. Reinboldt Dietz, that Muscios' work was but taken from Soranos, the Ephesian, who lived in Rome a short time before Galen.

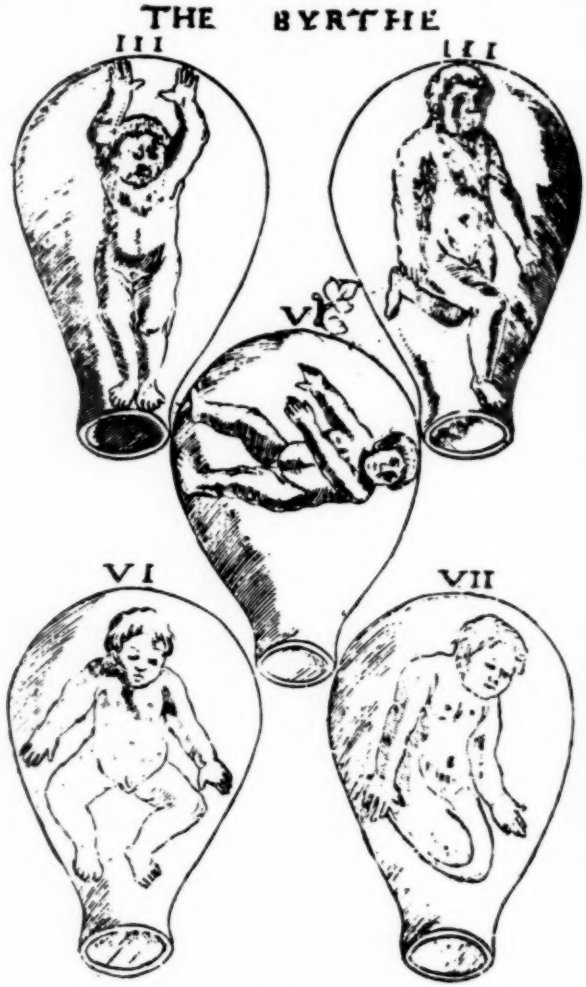


Fig. 6.

The first plate bears the caption "Birth Fygures," the other three are called "The Byrthe Fygures," with these words as one heading extending across the top of the second and third plates.

The uterus in all the figures looks like a Florence flask, each with a child, twin, or monstrous pregnancy stretched out at full length with the arms over the head in almost every attitude of the gymnast. Fisher thought the ages of the fetus might be anywhere from one to ten years, but many look years older, with the faces of old men.

Proper illustrations from an anatomical point of view are not found in medical literature until Smellie in 1754, and it could be found in the great institutions of learning, and it was not until the 19th century that the average midwife felt that

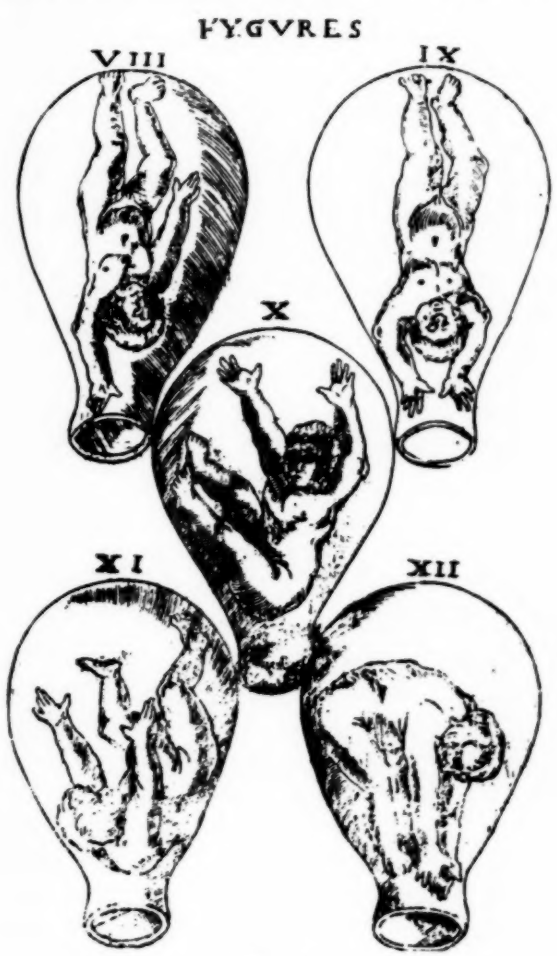


Fig. 7.

Fig. 8.

Figs. 5, 6, 7, and 8. The byrthy fygures and womans stowle, 1540 edition figures. Reproduced for the first time here. Possibly first copper plate impressions in England.

William Hunter in 1774, published their work.

THE BIRTH STOOL

The obstetrical chair, birth bench, birth stool, or woman's stowle of Rösslin is exactly like the chair of Soranos. It flourished in Greece and Rome, was well known to Soranos and Galen, and later to Aëtios, Aeginetes and Avicenna, apparently surviving best in Italy. Its modifications were numerous, and all sorts of mechanical contrivances were added to it, in the hope of assisting delivery. In the 17th century she could do without it. In our own times we have seen attempts made to revive it. Mauriceau in the 17th century was the first to make routine use of the bed for delivery. Among primitive peoples the delivery posture was anything but lying down; they were delivered standing, suspended, sitting, squatting, kneeling, or semi-recumbent either on the lap of an assistant, in a chair, on the floor, or the ground.

The antiquity of the stool has interested many, and the famous chapter of Exodus has often been quoted. Pharaoh speaking to two midwives, said: "when ye do the

office of midwife to the Hebrew women, and see them upon the stools, if it be a son, then ye shall kill him . . . "

Engelmann was convinced that its antiquity had been vastly overrated, and he translated the ancient Hebrew word *ebnaim* in this passage, as stones not stools. Soranos however, describes the chair exactly as Rösslin pictured it, and speaks of it as being used by Herophilos. This is enough to assure us of its antiquity, as it was certainly known to the Alexandrian School. Rösslin's picture is the first found in the literature. "The midwyfes," he says "have stoles for the nonce, whiche beynge but lowe, and not hye from the grounde, he made so compasse wyse and cave or holowe in the middes that that mai be receaved from underneth which is looked for."

HISTORICAL RETROSPECT

The importance of this curious book is best estimated in terms of the "Rosengarten," which Fasbender calls a milestone in the history of midwifery. Purely a compilation, or review, containing nothing new, it simply collected material, from the ancient and medieval periods, Hippocrates and Galen to Avicenna and Albertus Magnus. It was written in a language understood by those whom it was intended to reach, the ignorant midwives of the time. Rösslin has been called the teacher of the midwives of Europe.

Although usually referred to as the first book on obstetrics, this is not quite true, as Ortolf of Bavaria had written a little book, without date or title, which never attained more than scant attention and little circulation. Rösslin's book however went into a hundred editions. Although he died in 1526, long before the publication of the English edition, he saw it translated into Dutch in 1516 and Bohemian in 1519. There were 28 Dutch translations up to 1742.

The book marked the renaissance of obstetrics which had languished for fourteen centuries. It was certainly the highest authority on obstetrics in the 16th century. It accomplished only a little in the revival of the lost art of podalic version, for which Paré and his pupil Guillemeau did so much later. It was not until the latter part of the 17th century, however, by the teaching of Mauriceau especially, that this operation became an important obstetric procedure.

With the fall of empire in Egypt, Greece and finally Rome, the art of midwifery declined. The fairly well developed knowledge of those periods waned and was almost lost. Aëtios in the 6th century was the last to mention podalic version, a thousand years before Paré. A search of medieval literature yields but little worthy of note.

Modern medicine has its deepest and strongest root in the medical knowledge of ancient Greece, for Hippocrates in the 5th century before Christ, had elevated his art to a point which it did not reach again for six hundred years. In his time, although physicians assisted midwives, they were not highly regarded, but the midwives were recognized by law, and their duties clearly prescribed and understood. Such a condition did not occur again until 1555 in Ratisbon. About that time too a school for midwives was established at the Hôtel Dieu in Paris.

After the fall of Corinth in 146 B. C., their physicians deserted Greece for her stronger neighbor, Rome, where, at first unwelcome, they increased in influence and knowledge, until in the second century of the Christian era Soranos of Ephesus, a great physician, became the greatest obstetrician of antiquity. From his time until the publication of Rösslin's book, no progress was made. The obstetrical procedures of the Greeks were lost, and little more than mutilating operations were done upon the fetus.

Soranos himself did obstetrics, but with the next two hundred years, the physician as accoucheur passed so completely that his presence at a delivery not only was unwanted, but actually frowned upon by custom.

In Paré's time, the physician began to come into his own. Boucher later delivered

La Vallière, the mistress of Louis XIV, and Clement in 1682 officiated at the birth of the Dauphin. He received the title of accoucheur, but the word man midwife persisted until the last century.

There is no evidence that Rösslin ever delivered a patient. Ingerslev thought he was no doubt a famous and able obstetrician, while Siebold believed that he had no practical knowledge of obstetrics whatever. At any rate in 1522 Dr. Wertt of Hamburg, disguised in woman's clothes in order to witness a delivery, was burned to death for his pains.

No picture of Rösslin can be found, but some idea of his appearance can be gained from the woodcut in his book, which shows him presenting his book to the Duchess of Brunswick, his patroness. Of his life and attainments, we know little more than that previous to his becoming city physician of Frankfort, he had been a doctor in Worms.

The curious title of his book is of interest. Haggard thinks that Rösslin, probably never having seen a child born, felt the humor of his position; the book was a "Garden of Roses for pregnant women and for midwives." Choulant connects it only with the name of the author, while Ingerslev thought a botanical title was selected because Germany from its earliest time was a fertile field for the sale of books of that sort.

All these things are of great interest, yet possibly of very little value except to those who are concerned with tracing the beginnings of our obstetric art.

I would like to include the entire book, but that is of course impossible. So few have seen it. Copies of Jonas' translation are not available, although it seems that its quaint language, old spelling, curious prescriptions and medieval advice would appeal to every one interested in obstetrics. A few excerpts follow:

Of deade byrthes . . . and by what meanes it may also be expelled . . . Fyrste without instrumentes with this fumigation: take other the hove or dunge of an asse, and put it on coles, and lette the woman receave the fume underneathe. Another: take the skynne of an adder, castoreum, brymstone, galbanum, oppoponcum, madder that the dyerres occupye, pygeons dunge, or hawkes dunge: beate all these to powder, and temper them with oxe gall, and make pylles of it each of the quantite of a fylbert nutte, and then put one after another in the coles, and receave the fume thorowe a pype or conduyte made for that purpose in to the privities.

Fourteen other methods follow.

On how to determine sex:

. . . but if ye be desirous to know whether the conception be man or woman: then lette a droppe of her mylke or twayne be mylked on a smoothe glasse, or a bryght knyfe, other elles on the nayle of one of her fyngers, and yf the mylke flew and spredde abrode upon it, by and by then is it a woman chylde: but yf the droppe of mylke contynue and stand styll uppon that, the whiche it is milked on, then it is a sygne of a man chylde. Item yf it be a male, then shall the woman with chylde be well coloured, and lyghte, her belly rounde, bygger towards the ryghte syde then the lefte, for alwayes the man chylde lyeth in the ryghte side, the woman in the lefte side.

Yf it chance that the woman in her labour dye, and the chylde hauyng lyfe in it: then shal it be meete to kepe open the womans mouth, and also the nether places; so that the chylde by that means both receave and also expell ayre and breath, which otherwyse myght be stopped, to the destruction of the chylde.

I could not conclude without offering my earnest thanks to Mr. Charles Frankenberger, Librarian of the Medical Society of the County of Kings, whose enthusiastic, tireless help in research has been a great help to me.

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* Continued from page 90.

BOOK REVIEWS

AN INTRODUCTION TO GYNECOLOGY. C. Jeff Miller, M.D. St. Louis, C. V. Mosby Co., 1931.

Dr. Miller needs no introduction to the medical profession of this country. His accomplishments have been many; the honors bestowed upon him have been earned by years of endeavor.

The beginning of his preface is characteristic: "It is incumbent upon the author of a new textbook of gynecology, in view of the many excellent ones which already exist, to offer an explanation of his performance, if not an apology for it. In my own case, my teaching experience of more than twenty-five years has convinced me that the larger treatises on gynecology, scholarly and comprehensive though they be, do not answer the need of the beginning student for the reason that he lacks the ability to use them selectively." With that idea in mind Dr. Miller wrote an outline of gynecology for his students.

The book is composed of sixteen sections, amply illustrated, and covers the subject except that therapy is not considered. This, because the author considers "therapy must be based upon a comprehension of the disease to be treated and should be reserved until proper foundation has been laid."

Do not get the idea this work is of value only to undergraduate students. Any physician may well read and reread it with pleasure and profit.

THE COMMON SENSE OF DRINKING. By Richard R. Peabody. 191 pp., Boston, Little Brown, & Co., 1931.

The publisher's statement that "This is not an argument either for or against the Eighteenth Amendment, but rather, an acute and personal analysis" must be admitted to be borne out by the book itself.

In the Introduction, the author states that "For the more responsible concerns of life, a state of mind wherein the individual *actually does not want to drink* must be attained." The attainment of such an object would be a very desirable state of affairs. There is no doubt but that "The Common Sense of Drinking" is summed up in this statement.

Mr. Peabody, in 200 pages, makes a very good case for his theme. He offers in the way of remedy the application of common sense but, after all, applying that, we would not have had the problem at all. Therefore in the race towards solving the problem, the solution seems to have been left at the post. However, there can be no question but that this book, if properly read and digested, will have a wholesome effect.

Written by a trained scientist, the problem is faced in a rational and logical manner rather than emotionally as is the case with most arguments on this question today. The "excuses" for drinking are knocked in the head, one after the other. The "necessity" for alcoholic stimulation would seem to be disproved and all of this without any preaching or dogmatism. A thorough study of this book and the application of its teaching would do more to solve our great national problem than all the constitutional amendments that might possibly be devised.

TABELLEN ZUR DOSIERUNG DER RONTGENSTRAHLEN (Roentgen Ray Dosage). By Prof. Dr. L. Grebe, Director, Roentgen Institute, University of Bonn, and Dr. Phil. K. Nitzge, Bonn. With seven graphics. Supplement to *Strahlentherapie*, Vol. XIV. Berlin, Urban and Schwarzenberg, 1931.

The authors do not purpose to present a textbook on radiation therapy, but rather to furnish a number of tables which will permit the more accurate employment of dosage in clinical radiation therapy. There is first a chapter on the measurements of roentgen rays and a discussion of roentgen ray absorption. The very important subject of scattered radiation is gone into carefully, as well as the relative depth dose for a given intensity of superficial radiation. The remainder of the book, comprising more than 150 pages, is devoted to tables relating to spark gap, half-value layers, filters, including paraffin, water, aluminum, copper, zinc, lead, and air, and different sizes of ports of entry (fields of radiation) from 400 sq. cm. down to 50 sq. cm. For those engaged in deep *x*-ray therapy, such a book of tables furnishes a mass of data of great importance.

TEXT BOOK OF PHYSICAL THERAPY. By William Benham Snow, M.D., Vol. I, 708 pp., N. Y., Scientific Authors' Publishing Co., 1931.

This book is stamped "Vol. 1" on the backbone, but there is nothing to indicate either

on the title page or elsewhere how many volumes there will be altogether.

The book before us is divided into three sections: (1) Direct Currents, Constant Current and Static Current—20 Chapters; (2) High-Frequency Currents—14 Chapters; (3) Electrosurgery—8 Chapters. It is avowedly a plea for physical therapy by one of the most enthusiastic adherents of this method of treatment.

The following paragraph at the beginning of the Introduction is indicative of the handling of the entire subject: "Physical therapy in its scope provides a means of correcting displacements by readjustment and supports, and in removing inflammatory exudates, which is not possible by drugs, surgery, or the other departments of therapy. The swelling occurring from the effects of trauma—the local stasis engorging affected parts of the organism—resist all passive measures. The inflammatory exudates in neuritis, the swollen joints with arthritis, the congested glands internally, as of the liver, pancreas, spleen, or prostate, and any other part of the organism which may become engorged either from trauma caused by accident or the developments of infection which disturb the circulation and so impair the normal function of the parts involved or from other cause, likewise require a vis a tergo to relieve each condition. These disturbed conditions may be relieved sometimes by exercise, massage, mechanical vibration, or some form of radiant energy, but when not the seat of infection the static modalities will remove exudations in the early stages before fibrosis ensues." With such broad statements it is felt not many will agree.

The following quotation from the Preface further indicates the author's predilection for empiricism: "Clinical experience alone can furnish data broad enough to prepare the treatise now undertaken and clinical evidence will be considered as laboratory work, the same as in other medical investigations. A series of clinical studies in a class of similar cases, with established definite results, is the best clinical proof that can be given of the efficacy and indication for the employment of therapeutic measures or methods."

This book represents the school of physical therapists who feel the necessity for proving, to their own satisfaction at least, that their particular method or methods serve as a cure all for all the ills that flesh is heir to.

The credo of the rational physiotherapist is well expressed by Stewart in the Preface to his work on Physiotherapy[1]: "It cannot be emphasized too strongly that the author does not consider physiotherapy as an end in itself but he feels rather that it is an invaluable adjunct to other methods of treatment, and is one which has not yet received its deserved recognition in scientific therapeutics." This seems to be too conservative for acceptance by the author of the formidable volume before us. There are numerous case reports almost invariably winding up with such statements as: "At the end of a week, he was completely relieved of his trouble." . . . "After the second treatment I maneuvered a readjustment. These treatments completely cured this case." . . . "Only two treatments were required for this case, when he was in a normal condition."

A rather startling statement is made in the report of a case of traumatic arthritis: "He was referred to——to have a hip splint made that would keep all weight off from the knee. When he went for the splint he asked the workman how long he would have to wear it. The reply was 'as long as he lived.' He paid for it, hung it in his closet, and came to the author for treatment."

It would be interesting to know in this case what the doctor who prescribed the splint thought of the "workman's" prognostication. There seems to be little if any follow-up to any of the cases. The fact that the patient left the author's office satisfied seems to be accepted as evidence of a cure.

Every form of physical therapy is here considered from gymnastics to radiology. The treatment in some form seems to be applied to practically all diseases running the entire gamut of functional and organic disorders. The sincere enthusiasm of the author appears on every page. Quotations are largely of his friends in the American Physiotherapy Association of which the author was president while it was still the American Electrotherapeutic Association.

Physical therapy is rapidly acquiring a high scientific status. It is with regret that we see a book of this kind published under a 1931 imprint. It had been hoped that Physical Therapy, as discussed in this work, was a thing of the past.

[1] Stewart, H. E. Physiotherapy. Theory and Clinical Application. Ed. 2, N. Y., Hoeber, 1929.

PRINCIPLES OF PREOPERATIVE & POSTOPERATIVE TREATMENT

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PRINCIPLES OF PREOPERATIVE & POSTOPERATIVE TREATMENT

Chapter X

URINARY DISTURBANCES

Urinary disturbances constitute a fairly important, because frequently encountered, group of postoperative complications. There occur (1) the group of malfunctions comprehended by the general term, "nephritis," (2) infections of the urinary tract, and (3) disturbances of urination as such.

1. Nephritis

Nephritis does not, properly speaking, constitute a complication of operative procedures; at least, ordinary operations never produce the condition of nephritis in kidneys not previously the seat of degenerative changes. Furthermore, proceeding on the assumption that certain cases of nephritis are produced, or at least unfavorably affected, by focal infections, it has been customary for a number of years to remove foci of infection as a part of the treatment of nephritis, and when indications are believed to exist major operative procedures, like the removal of appendix, gall bladder, or infected Fallopian tubes, are undertaken without hesitation even in the presence of an established nephritis. In this connection Mosenthal[1] states that "it is important to know that it is possible to operate in nephritic cases without fear provided such cases are not in a terminal stage; operative procedures apparently do not do any harm." Postoperative nephritis, therefore, represents merely a preexisting nephritis which may or may not have been influenced unfavorably by the surgical procedure. Inasmuch as such a nephritis constitutes essentially a medical rather than a surgical problem, no especial consideration need be given the matter in this treatise,

especially since such a discussion would involve an extensive digression.

II. Infections of the Urinary Tract

Postoperative infections of the urinary tract include (1) infections of the bladder: cystitis, and (2) infections of the kidney and its pelvis: pyelitis, pyelonephritis, and pyonephrosis.

Postoperative cystitis occurs characteristically only in cases which have required postoperative catheterization, and accordingly the discussion of this particular urinary infection will not be attempted immediately but will be reserved for consideration in connection with postoperative retention of urine and catheterization.

A. Pyelitis: The term pyelitis is used to designate any inflammatory process in the renal pelvis regardless of its etiology. Probably all cases of pyelitis are associated with a certain amount of inflammation of the kidney itself, a condition which collectively is designated as pyelonephritis in case the associated nephritis attains sufficient proportions. Pyelitis follows surgical operations in a small percentage of cases, 24 cases in a series of 7300 gynecological operations, or 0.33 per cent, according to Maloney and Cracco.[2]

1. *Etiology:* Undoubtedly many cases of postoperative pyelitis do not represent processes initiated during the postoperative period but, on the other hand, represent either acute or chronic processes which were overlooked at the time of the operative procedure. There is considerable evidence that pyelitis is not infrequently misdiagnosed appendicitis or cholecystitis, and the true source of the patient's symptoms becomes evident only after operative intervention has failed to provide the anticipated relief. Thus Van Dusen[3] found that 7.6 per cent of a series of 300 routine cases of pyelitis had been subjected to appendectomy for the relief of symptoms which still persisted after operation and were relieved only by treatment for pyelitis, and that 9 per cent of his cases had similarly been subjected to surgery of the gall bladder for symptoms

which persisted after the operation and were subsequently relieved only by treatment for pyelitis. The explanation of the development of idiopathic postoperative pyelitis seems to be that the trauma and shock incident to surgical intervention lower the general bodily resistance and thereby predispose to infections of all sorts, the development of pyelitis usually being purely incidental to this.

Pyelitis occurs about six times as frequently in the female as in the male, and accordingly may be regarded as practically a disease of females. The reason for the sex incidence seems to be in some way connected with the proximity of the ureters to the internal genital organs in the female; pregnancy and possibly even menstruation may be accompanied by sufficient congestive swelling of the urethers to narrow the lumen, cause temporary compensatory dilatation of the renal pelvis, and thus favor infection. In unilateral infections the right kidney pelvis is the one commonly affected.

The Bacillus coli communis is the organism most frequently found (between 75 and 90 per cent of the cases), but the Staphylococcus albus and the streptococcus are occasionally responsible for the infection. The focus of infection from which these organisms are derived undoubtedly varies, but the intestine must obviously be the ultimate source of the commonets invader, the B. coli; in this connection it has been found that the cecum and ascending colon have direct lymphatic connections with the right kidney, a condition which is not found to obtain on the left side, and very possibly this fact may account in some degree for the greater incidence of right-sided pyelitis. It is usually believed, however, that pyelitis frequently represents a blood-borne infection and in this connection must be considered the danger of liberating organisms into the blood stream during appendectomies, manipulation of a pyosalpinx the result of a mixed infection, and hemorrhoidectomies; also operative incisions about the rectum and perineum which latter must almost inevitably be contaminated by the colon bacillus. Kretschmer[4] has called attention to the possibility

of chronic constipation as an etiological factor, 30 per cent of 200 cases collected by him having given a history of such a condition.

2. *Symptoms:* The most frequent symptom of pyelitis is pain. It occurs in about 70 per cent of cases and varies in severity from an occasional dull ache, either in the loin or along the course of the ureter, to a very severe stabbing pain like that seen in impaction of urinary calculi. Frequency of, and burning on, urination constitute the next most characteristic symptoms and are found at one or another stage in the course of the diseases in about 35 per cent of cases. Fever is present in only about 25 per cent, and urinary blood can be found in about 10 per cent of the cases. About 7 per cent of cases present no symptoms referable to the urinary tract at all (Van Dusen[3]).

The diagnosis is made, of course, on the finding of pus in the urine, and the degree of pyuria may vary from a few cells in a single microscopic field to macroscopic pus. Absence of pus from a sample of urine does not, however, necessarily eliminate a diagnosis of pyelitis, because the ureter leading from the affected kidney may have become temporarily blocked, and conversely the discovery of pus in a sample of urine does not necessarily indicate pyelitis unless the urine has been obtained by catheterization of a ureter, because pus may find its way into the urine not only from the kidney pelvis but from the urinary bladder, urethra, prostate and seminal vesicles, or from the external genitalia especially in females.

Clinically pyelitis may conveniently be classified in two types, (1) that in which the symptoms are confined to a dull ache in the loin and pus in the urine, and (2) that in which there is a fever of 100°F. or more, in which the pain in the loin is more acute and persistent, and there are symptoms of dysuria. Inasmuch as inflammation when confined to a mucous surface is never responsible for severe systemic reactions the more acute cases invariably present some complication,

such as a metastatic abscess of the cortex of the kidney or secondary infection in a preexisting hydronephrosis.[5]

3. *Diagnosis:* Although pyelitis may be suspected when pus and organisms are found in the urine, the diagnosis can be made with certainty only after cystoscopy and ureteral catheterization, for the reasons previously mentioned. On cystoscopy the characteristic finding in pyelitis is a moderate cystitis most evident about the ureteral opening of the affected side, the ureteral orifice itself being hyperemic and swollen and the urine issuing from it being cloudy. Separate catheterization of the uterers and subsequent cytological and bacterial examination of the urine delivered from each serves to differentiate monolateral from bilateral pyelitis.

4. *Treatment:* In postoperative pyelitis conservative treatment usually suffices to affect a cure, and the time required usually does not exceed three weeks. Conservative treatment consists of (1) rest in bed, (2) stimulation of the emunctories, by gentle purgation in the case of the bowel, especially by mineral water, diaphoresis in the case of the skin, and forcing fluid in the case of the kidneys, (3) the use of urinary antiseptics, hexamethylenamine and sodium acid phosphate or salol, or possibly some of the newer drugs like hexylresorcinol, either alone or in alternation with alkali therapy, though these have by no means been universally used with success, and (4) the eradication of foci of infection as rapidly as the skill of the medical attendant and the condition of the patient permit. Undoubtedly the most important factors in the treatment are the enforcement of rest in bed and the physiological lavage of the renal pelvis which results from ingestion and subsequent elimination of large quantities of water. Under conservative therapy by far the larger percentage of cases of postoperative pyelitis undergo spontaneous resolution.

If at the end of three weeks the infection has not subsided, or previously to this in cases which do not make satisfactory progress as shown by frequently repeated examinations of the urine and subsidence of symptoms, the advisability

of adopting more radical therapy should be considered, cystoscopic treatment.

Cystoscopic treatment consists in ureteral catheterization either alone or reinforced by subsequent lavage of the pelvis of the kidney. This form of treatment is indicated especially in those cases which present evidence of ureteral obstruction. The commonest manifestations of such obstruction are septic states characterized by recurrent chills and attacks of high fever, extreme prostration, and the development of palpable masses in the renal areas.

Pelvic lavage consists of introducing the ureteral catheter into the pelvis of the kidney and irrigating through the ureteral catheter with warm physiological salt solution until the solution returns quite clear. Instillation of 1 per cent silver nitrate solution to the capacity of the structure is frequently performed as an additional measure before the catheter is removed; this latter solution is left in situ. Lavage is usually repeated once or twice a week for several weeks. If this treatment proves unsuccessful twenty-four-hour continuous drainage of the ureters may be instituted, lavage and instillation of silver nitrate solution being performed at least twice during each twenty-four-hour period of continuous drainage.

Cases of postoperative pyelitis which do not respond favorably to simple conservative treatment should, of course, be placed in the hands of a competent genitourinary surgeon, and for this reason the discussion of specialized forms of treatment for pyelitis is merely summarized in this discussion.

B. PYELONEPHRITIS AND PYONEPHROSIS: Pyelonephritis and pyonephrosis are, of course, conditions of the utmost importance to the genitourinary surgeon, but are of relatively little importance as postoperative complications because they occur uncommonly in the practice of general surgery. Both of these conditions, however, may represent merely the further progress of a simple pyelitis and consequently merit brief discussion.

In pyelonephritis there occurs concurrent infection of both the pelvis of the kidney and the kidney itself. The differentiating feature between a simple pyelonephritis and a pyonephrosis is entirely clinical and depends upon the fact that in the former no interference with kidney function can be determined, whereas in the latter by the use of the familiar dye-excretion tests the function of the affected kidney may be shown to be diminished. The method of estimating kidney function by the use of dyes is sometimes designated as chromocystoscopy.

Pyelonephritis may occur in three clinical forms:

(a) The more common or mild form which differs in no essential particulars from moderately severe simple pyelitis. The patient, however, usually exhibits more pronounced symptoms of toxemia, micturition is commonly frequent and painful, and definite attacks of polyuria tend to occur. The urine contains pus and frequently blood.

(b) The ordinary acute form, which is characterized by a still more profound systemic reaction, pyrexia, headache, anorexia, alternating attacks of constipation and diarrhea, and pain and tenderness in the loin, together with pyuria and reflex bladder symptoms, as in the former variety, and

(c) The fulminating form in which there is an acute onset with definite rigors, pyrexia to 104°F., vomiting, diarrhea, acute pain in the loin, and subsequently delirium. In these cases little urine is evacuated, and such as is voided contains blood, albumin, and pus. Death commonly ensues within a week regardless of the treatment employed.

Pyonephrosis represents a condition in which considerable gross and microscopic destruction of the renal parenchyma is occurring or has occurred. In the severest forms little remains of the kidney or its pelvis except a connective tissue envelope containing pus. Except in those cases in which blockage of the ureter occurs the symptoms of pyonephrosis may be exactly the same as those of pyelonephritis; indeed, the dividing line between the two conditions cannot be drawn clinically. Obstruction to the ureter produces a rapid exaltation of

virulence of the bacteria present, and sudden high fever and severe renal pain soon follow; the area over the kidney may become very tender and the kidney itself may become palpably enlarged.

Pyonephrosis represents a degeneration of kidney substance so extensive that usually when monolateral the best treatment is nephrectomy, providing the function of the remaining kidney is deemed sufficient to warrant such a procedure; nephrectomy may also be advisable even in the more severe varieties of pyelonephritis. Otherwise the treatment of these two conditions as postoperative complications is largely prophylactic and accordingly the same as that for simple pyelitis.

III. Disturbances of Urination

Under the heading of "disturbances of urination" is considered that subdivision of urinary complications in which the mechanics either of the formation of urine or of its subsequent passage from the kidney along the excretory system to the external urinary meatus is deranged so that none, or at least only a part, of the normal quantity of urine, is discharged. This implies that such urine as is formed is normal in character. Diminished output of urine is, of course, encountered both in infections of the urinary tract and in nephritis at times, but such a diminution of urinary output is not primarily of mechanical origin, and the urine which is discharged is characteristically found modified in accordance with the nature of the particular infection or renal change present.

This use of the term "urination" probably does some violence to the most commonly accepted sense of the word. By "urination" one usually means the relaxation of the internal and external urethral sphincters and the discharge from the body by vesical muscular contraction of urine previously contained within the urinary bladder. However, as Rehfisch[6] in 1895 showed, the internal sphincter alone is capable of adequately performing the function usually per-

formed by both sphincters; and as Young[7] has shown, the reverse is also true, the external sphincter alone being adequate to control urinary evacuation. When both sphincters, moreover, are paralyzed or otherwise incapacitated the urinary dribbling from the urethra is also called urination, although such urination is usually qualified by the term "involuntary." Urination, therefore, may occur quite in the absence of the function of both sphincters; in such cases muscular contraction of the bladder is unnecessary because the bladder no longer functions as a reservoir.

Thus the term "urination" is still used when the so-called "act of urination" has ceased to be an act in any proper sense of the word at all. Furthermore, the generic sense of the word is merely the evacuation of urine, and as such evacuation is normally dependent upon the integrity of the kidney and ureter as well as that of the bladder and urethra no real violence is done to terminology when urination is used as a comprehensive term connoting the mechanical function of the entire urinary tract from kidney to external urinary meatus.

Failure of a patient to pass urine in normal amounts postoperatively may obviously be due (1) to failure of the kidneys to secrete, or (2) to mechanical obstruction to the passage of urine somewhere along the course of the excretory system, ureters, bladder, or urethra.

A. THE CLINICAL TERMINOLOGY, "ANURIA, OLIGURIA, RETENTION, SUPPRESSION": The urinary tract has been so generally divided for purposes of anatomical and clinical discussion into "upper" and "lower" portions that it is not surprising to find a corresponding dual division of the physiological terminology.

Etymologically "anuria" and "oliguria" should mean respectively the "situation in which no urine is passed from the body" and the "situation in which the quantity evacuated is less than the normal amount," but actually both of these terms as commonly used refer only to dysfunction of the upper urinary tract, viz., the kidney and ureter. Dysfunction of the

bladder and urethra in the direction of diminished urinary output is designated "retention."

Thus when urine is normally delivered to the bladder, but because (a) of interference with the sensory stimulus to urination, (b) of interference with the contractile power of muscular elements in the wall of the bladder, or (c) of mechanical obstruction to the normal excretory duct of the organ, the urethra, the condition is said to be one of urinary "retention." When, on the other hand, whether due (a) to failure of the kidneys to secrete normally or (b) to obstruction to the passage through the ureter of urine already formed, a reduction in the amount of urine delivered to the bladder results, a condition of partial or complete "anuria" is said to exist. "Oliguria" is, of course, the condition of partial "anuria."

The distinction between the type of anuria or oliguria due to failure of the kidney to secrete and the type due to the failure of the ureter to excrete has been emphasized to a considerable extent in the past, and the two forms of dysfunction have been called respectively the "secretory" and the "excretory" types, or according to another terminology the "prerenal" and the "postrenal" types. It must be remembered, however, in using the terms "excretory" or "postrenal" in connection with anuria that these terms apply only to ureteral obstruction and not to the chain of urinary disturbances which may occur further down in the urinary tract; they are consequently equivalent to another term not infrequently used in this connection, "suppression."

B. Secretory or Prerenal Anuria:

1. *Etiology:* a. Reflex Anuria: There is some dispute as to whether pure reflex anuria ever occurs. A considerable number of authorities, among whom are Guyon, Israel, Albarran, Kummell, Hammesfahr, Neuwirt, and Fruchard-Brin,[8] believe that reflex anuria is a distinct clinical entity. Keyes, Legueu, Rovsing, Casper, and Watson[9] on the other hand believe that the condition of true anuria is so rare that they doubt its existence at all.

According to Neuwirt[10] the reflex involves the nerves which contain the vasomotor supply to the kidneys and the splanchnic nerves. He says that division of the splanchnic nerves gives rise to a polyuria, whereas irritation of these nerves, such as would occur as the result of ligation of the pedicle of the opposite kidney, would tend to produce a vasoconstriction with resulting oliguria or anuria. In expansion of this theory Neuwirt suggests a method of treatment which consists of anesthetizing both splanchnic nerves (splanchnic anesthesia by the technique of Kappis) with a solution of novocaine, and he has been able to apply this therapy in one clinical case with startlingly good results.

Certainly true reflex anuria occurs, if at all, as a relatively rare condition, and in the absence of some factor not readily apparent it would seem well-nigh impossible to understand why it should occur so infrequently if it does indeed constitute an essential clinical entity. Anuria has been reported most commonly following operations involving the more serious kidney operations, such as nephrectomy and nephrotomy, and seems to occur especially in connection with such procedures as involve ligation of the kidney pedicle and ureter of the opposite side, but only a relatively small number of such procedures are complicated by anuria. Similarly, various intra-abdominal operations, such as appendectomies and operations on the biliary tract, have occasionally presented this complication, but the percentage of such cases is so low as to be almost negligible. Many authorities of large operative experience who have had the opportunity of following a considerable number of cases to autopsy are inclined to believe that a great proportion of the cases of so-called reflex anuria are really dependent upon actual degenerative processes in the kidney, such as acute or chronic inflammatory changes, hydronephrosis, the presence of calculi, and renal tuberculosis.

Clairmont and Von Heberer,[11] and Staheli[12] have reported cases associated with gall-bladder surgery, and the last-named

author believes that a definite correlation in function between the liver and kidney exists such that disease of the liver, especially disease associated with icterus, is commonly associated with parenchymatous nephritis. He suggests that these changes are characterized by the presence in the circulation of bile acids, bile pigment, or other toxic products which have been formed as the result of impaired hepatic function and have failed to be properly excreted by the kidney. If this conception of anuria be correct the treatment of the condition would be largely prophylactic, would consist of careful determination of kidney function preoperatively, and in cases of doubt cystoscopic examination and catheterization of the ureters to make sure of their patency.

Probably in most cases at least, the condition represents merely the response of a kidney previously damaged to an extent such that it is unable to cope with the additional load placed upon it by the operative procedure or by the immediate effects thereof. This is essentially the teaching most commonly adopted even by the proponents of the theory of true secretory anuria, as they are inclined to admit that only a kidney previously diseased is subject to the reflex influences producing reflex suppression. It must be added, however, that instances of reflex anuria have apparently followed nephrectomies even in cases in which previous cystoscopic examination had shown that the kidney removed was practically without function, whereas the other functioned in a manner sufficient to care for the ordinary needs of the organism.

Patients exhibiting this complication usually present symptoms of slight drowsiness but no alternation of consciousness; headaches are unusual, and respiration and pulse rate are often relatively normal. In fact, the patient frequently shows no physical signs suggestive of the existence of a condition of perverted excretory function. Under these conditions, however, the urea concentration may be of the order of magnitude of 400 mg. and that of creatinine of the order of magnitude of 13.5 mg. per 100 c.c. of blood.

The prognosis is usually essentially the same as that in cases of acute nephrosis, such as is seen in bichloride of mercury poisoning. Many of them recover satisfactory, or normal, function within the course of a few days.

Therapeutically little can be done for such cases beyond the administration of a low protein and salt-free diet and the administration of from 2500 to 3000 c.c. of fluid daily, which amount can frequently be administered per os.

b. Secretory Anuria Secondary to Low Blood-Pressure: There is certainly one type of anuria which can be classified as secretory and which is not reflex in the formerly applied sense of the term, the anuria secondary to low blood-pressure. Physiologists have shown that failure of urinary secretion may be expected to occur in normal individuals whenever the blood-pressure in the renal artery decreases below about 40 mm. of mercury pressure. In patients, subjects of hyperpiesis, in whom the kidneys have become accustomed to higher blood pressures than normal an even greater blood-pressure than this may be inadequate to maintain urinary secretion. Failure of urinary secretion in patients in shock is thus explained and probably also those cases in which the sudden withdrawal of urine from cases with prostatic obstruction is followed by anuria, for it has been shown by O'Conor and others[13] that the resultant sudden decompression of the kidneys is characteristically followed by a marked fall in the systemic blood pressure sufficient to induce the type of suppression under discussion.

c. Secretory Anuria Secondary to Blood Concentration: There can be no doubt in the light of some of the more recent researches in connection especially with the pathology of burns and intestinal obstruction, that a condition of extreme concentration of the blood is inconsistent with urinary secretion. Complete suppression of secretion is not particularly common from this cause, it is true, but the possibility of such an occurrence should be remembered, and the medical attendant

should be especially on his guard against the development of the less severe grades of such a condition.

2. *Treatment:* The preceding account of the secretory anurias, admittedly fragmentary and incomplete in the present state of our knowledge, justifies little dogmatization with respect to active therapy beyond the fairly obvious indications for restoration of normal blood-pressure levels in cases secondary to low blood-pressure or dilution of blood concentration.

The treatment of secretory anuria of reflex origin especially, and that of the last mentioned types to a lesser extent, is fundamentally prophylatic. Reflex anuria in the healthy kidney being virtually unknown, the indications are for a very careful and accurate survey of the condition of the kidneys preoperatively in all surgical cases, but especially in those of the more severe kidney operations and those in which dependence must be placed postoperatively upon the function of a single kidney. Measurements of kidney function by any single method are unsatisfactory for this purpose: a combination of all methods is highly desirable, especially the "Mosenthal," the "dye-excretion," and the "urea-concentration" tests.

In the presence of an established case various alternatives have been suggested one or another of which may prove successful in some cases, whereas a combination of all of them may be ineffective in others. Perhaps the best single form of therapy is intravenous infusion of dextrose; a large quantity, 750 to 1000 c.c. of a 5 per cent solution may be tried, and a repetition of the dose should be made as often as may be deemed advisable in case the first infusion or subsequent infusions are unsuccessful.

Reestablishment of urinary secretion has also been reported following catheterization of the ureters. As a last resort, and usually ineffective, the capsular stripping operation of Edebols may be tried, but the latter probably offers very little prospect of success.

c. Postrenal or Excretory Anuria and Oliguria: Any condition which occludes the lumen of the ureters will give rise

to the development of a condition of postrenal or excretory anuria. Frequently the obstruction is temporary and incomplete but it may be both complete and permanent; the latter condition is, of course, inconsistent with life.

1. *Periureteral edema, Extra-Ureteral Tumors, Section of the Ureter:* a. Etiology: Perhaps the most frequent cause of postrenal anuria is the edema which follows operative manipulations upon, or trauma in the region of, the ureter. Operations upon the organs of the female pelvis, especially the performance of hysterectomy and salpingectomy, because of their involvement of manipulations in the immediate region of the terminal portions of the ureters are particularly likely to be followed by partial and temporary ureteral occlusion, and this is particularly true of the operation of extensive anterior colporrhaphy, following which there is characteristically a marked edema of the vesical wall which tends to occlude the intravesical portion of the ureters. It is not at all unusual for a greatly diminished urinary output to be noticed for the first twenty-four to forty-eight hours following such an operation. That this is the abnormality responsible in such cases can be demonstrated by cystoscopic examination and an attempt to catheterize the ureters.

Carcinoma of the cervix, prolapsus uteri, and tumors and tumefactions in the broad ligaments may not infrequently lead to excretory anuria and the production of a bilateral hydroureter as the result of a simple pressure effect.

The inclusion of one or both of the ureters in a ligature, or, less frequently, the complete severance of the ureter during the course of an operation is not a particularly rare operative event especially at the hands of the unseasoned surgeon.

b. Treatment: The treatment of such complications as have just been detailed is largely prophylactic, as will readily be appreciated from a consideration of the pathology. Gentle handling of the tissues in the region of the ureters is of the utmost importance in avoiding undue postoperative edema.

2. *Calculus Anuria:* Calculus anuria represents a condition in which urinary calculi previously present but giving rise to no symptoms are dislodged and eventually block the ureter. The condition is encountered very unusually as a postoperative complication although a considerable number of cases have found their way into the literature at various times. As early as 1895 Legueu[14] was able to report a series of 86 cases, and Morris,[15] in 1901, presented an analysis of 104 cases.

Blockage of only one ureter in the aforementioned manner would, of course, result seriously only in case the function of the opposite kidney was unduly disturbed; such would be the case

(a) in congenital absence or operative removal of the opposite kidney,

(b) in complete or virtually complete destruction of the opposite kidney by disease,

(c) in the condition of reflex anuria of the opposite organ, and

(d) in the condition of double calculus impaction.

Urinary calculi occur bilaterally in about 20 per cent of all cases; i.e., in approximately 1 case in 5, a consideration which indicates that the possibility of a bilateral calculus anuria is not altogether fanciful.

a. Symptoms: In experimental animals simultaneous complete occlusion of both ureters causes death in from four to five days, but clinically, complete anuria frequently does not result fatally for from one to three weeks or more. Caulk[16] classifies the symptoms in three stages: (a) premonitory, (b) tolerant, (c) uremic.

(a) *Premonitory Stage:* The onset of calculus impaction may be marked by the occurrence of typical colicky pains in the affected loin with a tendency for the pain to radiate toward the iliac fossa, toward the external genitalia, and down the inside of the thigh, classical "renal colic." In other cases there may be simply a dull ache in the region of the affected kidney in the absence of acute symptoms. In a certain number of cases there

may be no symptoms at all to indicate the onset of the condition or to indicate the side affected.

(b) *Tolerant Stage:* In the tolerant stage patients present no symptoms save that of anuria. On the passing of a catheter no urine is obtainable from the bladder, or at least only a very small amount, though the patient feels perfectly well. Sometimes the anuria is not constant, periods of complete anuria alternate with the voiding of large quantities of urine, the latter occurrence giving the medical attendant and the patient temporary and false relief from anxiety.

(c) *Uremic Stage:* In those cases in which infection is superimposed upon the condition of calculus impaction and anuria, the course of the condition is apt to be fulminant; patients present the symptoms and signs of acute nephritis seen in bichloride of mercury poisoning; the temperature is elevated, and early toxemia is an important and early development. In other cases the effects of the anuria are very insidious. Except for the blood chemistry findings there may be no evidence in the early stages of the condition of the suddenly developing and rapidly fatal uremia that is impending. Of this stage Keyes[17] says, "The patient seems well, eats and sleeps as usual, the pain has passed and discomforts are insignificant, and all the while there is brewing within him a crisis swift and terrible." Non-protein nitrogen figures as high as 150 mg. to the 100 c.c. of blood may be obtained during this period. Eventually the patient suddenly develops a condition of uremia and rapidly succumbs.

b. Diagnosis: The diagnosis of the condition is made by positive radiographic findings in the presence of anuria, but negative findings by radiographic methods do not eliminate the condition from consideration because (a) not all calculi are opaque to the *x*-rays, and (b) disease of the opposite kidney in the presence of a monolateral calculus could not thus be demonstrated. In doubtful cases the ureter or ureters should be catheterized.

c. Treatment: Prophylactically the treatment resolves itself into very careful determinations of the function of the opposite kidney prior to the removal of one of these organs and the recognition of calculi preoperatively in cases in which the symptomatology is suggestive of such a condition. The treatment after anuria has become established is never expectant; under such treatment there is approximately an 80 per cent mortality. The exhibition of atropine and benzyl benzoate or the administration of splanchnic anesthesia may be tried in the earliest stages in an attempt to produce relaxation of the ureters and to favor the passage of the impacted calculus, but temporization with such methods should not consume much time if it proves ineffective.

Cystoscopic manipulations and the introduction of a wax-tipped ureteral sound into the affected ureter offers the best prospect for relief. By this means the stone may be dislodged and passed or may be pushed back into the pelvis of the kidney and thus a subsequent resumption of kidney function may be vouchsafed. In the event of failure of such manipulations formal operative procedures should be invoked, pyelotomy or ureterotomy. Surgery is indicated early in all cases, certainly before the fourth day, and the natural history of the development of the condition should be clearly recalled to mind lest the apparent excellent condition of the patient be considered sufficient grounds for delay and the golden opportunity for surgical interference be allowed to pass unimproved. The mortality rate in the use of this kind of treatment should be comparatively low; Caulk[16] reported a series of 6 cases without a death.

D. Postoperative Retention of Urine: The term "retention of urine" is a somewhat unfortunate one inasmuch as within limits the retaining of urine is a normal function of the bladder, retention becoming abnormal only when unduly prolonged or exaggerated. The term has been so frequently used, however, in the sense of abnormal retention that misunderstandings from this source probably do not often arise.

Even though the bladder contains considerable urine patients frequently void with difficulty and only after relatively long periods of time following many operations, especially those performed under a general inhalation anesthetic and particularly after gynecological or rectal operations. The time limit beyond which failure to void becomes abnormal cannot be stated dogmatically since it depends, among other factors, on (1) the length of time elapsing between preoperative catheterization and the actual performance of the operation, (2) upon the extent to which the bladder was emptied at the time of this catheterization, (3) upon the duration of the operation itself, and (4) also upon the amount of fluid supplied to the patient immediately before or subsequent to that time.

1. *Failure to Void as a Result of Atony of the Urinary Bladder:* Ordinarily a patient who has been thoroughly catheterized just prior to operation can safely be allowed to remain undisturbed for a period of from eight to twelve hours following operation. At the end of this time, however, if spontaneous urination has not yet occurred an attempt should be made to determine the degree of distension of the bladder. Normally the bladder is, of course, a pelvic viscus, but when considerably distended it rises out of the pelvis and becomes an abdominal organ; in full distension the fundus of the bladder constitutes an ovoid tumor above the symphysis pubis the outlines of which may be determined by palpation and percussion, and in thin patients may be visually evident because of pressure exerted on the anterior abdominal wall. If on inspection, palpation, and percussion, the bladder is determined to be still within the pelvis at the end of from eight to twelve hours, no anxiety need be felt; if, on the other hand, one cannot be certain after careful examination that the bladder is not distended, or more especially if the fundus of the organ can be recognized well above the symphysis the question immediately arises as to the best means of inducing evacuation.

There is universal agreement among surgeons that spontaneous micturition should be induced if at all possible,

and there are certain rather classical measures which may and should be tried in an attempt to induce voluntary urination. The most valuable of these are the following: (1) placing of a hot water bottle or hot stupes over the bladder region, (2) douching of the external genitalia with warm water, (3) the administration, in selected cases, of a small hot enema (4 oz. at a temperature of 112°F.), (4) frequent changes of the patient's position in bed, (5) allowing the patient to hear the sound of running water, and possibly two other measures of doubtful value, (6) the intravenous injection of 5 c.c. of a sterile 40 per cent of urotropine, and (7) subcutaneous injections of pituitrin or caffeine-sodio-benzoate.

If after the expenditure of a reasonable amount of effort in the trial of these various measures spontaneous voiding does not occur there are two remaining plans of action either of which may be adopted: (a) the patient may be left undisturbed until such time as the pressure of accumulating urine within the bladder becomes so great as to overcome the natural resistance of the sphincters, or (b) catheterization may be performed immediately and may be repeated again and again thereafter as often as the bladder becomes distended until spontaneous action of the lower part of the urinary apparatus is resumed.

The fundamental objection to the immediate use of the catheter in the relief of postoperative urinary retention is the danger of infecting the bladder and secondarily the ureters and pelvis of the kidney, the danger of "catheter cystitis and pyelonephritis." Ordinarily the danger of inducing such complications postoperatively is probably not great when catheterization is performed with good aseptic technique, because the normal bladder is remarkably resistant to infection. Experimentally it has been determined over and over again in the lower animals that the injection of considerable quantities of virulent bacteria into the bladder does not produce cystitis unless the bladder itself is traumatized or unless it is already the seat of degenerative changes, and in human beings the

relative infrequency with which cystitis follows cystoscopy is further evidence of the natural resistance of the bladder to infection. Cystitis and pyelonephritis are, however, exceedingly disconcerting, even dangerous, and in certain cases fatal, postoperative complications, and there is probably no sure way of determining whether a given patient's bladder is, or is not, normal and therefore as immune to infection as it should ordinarily be. Accordingly, many believe with Willy Meyer[18] that urinary retention may well be allowed to persist unrelieved for thirty or even thirty-six hours before an attempt is made to force spontaneous voiding, especially in the male. This author cannot believe that the procedure does the patient any harm, though he does not advocate causing the patient an undue amount of suffering.

This conservative method is believed by many to be particularly applicable to those special cases in which retention is due to nerve lesions and in connection with traumatic injuries of the spinal cord such as are caused by fractures of the spine and gunshot injuries involving the cord either directly or by transmitted pressure. Thus Besley[19] and Cumming[20] advocate avoidance of the catheter insofar as possible in all cases in which urinary retention is due to spinal cord injuries; the former believes that in such cases the catheter should never be used, and the latter, although he is inclined to believe that definite injury is caused the kidney by this procedure, feels that this damage is not sufficient to contraindicate forcing the development of retention with overflow.

It probably is true that the amount of distention of the bladder and the degree of back pressure transmitted to the ureters and kidney in the adoption of the procedure under discussion are in the average postoperative case incapable of producing permanent damage to the urinary apparatus, and the method is therefore probably relatively devoid of danger; on the other hand, a considerable amount of suffering is undoubtedly engendered in many patients by such methods, and this probably constitutes the fundamental objection.

Furthermore, there is some evidence that a prolongation of the condition of retention with overflow produces definite deleterious organic changes. Thus Curtis[21] has shown experimentally that following paralysis of the bladder by division of the nervous control in rabbits cystitis developed in considerably more than half the cases, and that definite lesions in the upper urinary tract characteristically developed, distention of the ureters, nephritis, cellular infiltration of both cortex and medulla, renal hemorrhages, dilatation of the renal tubules, and occasionally extensive destruction of the kidney substance.

It is therefore probably better, providing the surgeon commands an intelligent and well trained nursing staff, to adopt the second alternative and to have patients catheterized either at the end of a definite number of hours, usually from eight to ten, or in case interne supervision is particularly good, after a variable period of time, viz., as soon as the patient complains of discomfort or bladder distention becomes recognizable. There is some evidence for believing that routine catheterization of patients who do not void after a certain definite number of hours is intrinsically much less desirable than the institution of catheterization in accordance with the indications of discomfort and physical evidences of distention.

Curtis[21] has observed that patients who require repeated catheterization postoperatively do not promptly regain the power to evacuate the bladder completely and that the presence of residual urine predisposes to cystitis. In order to determine the possible influence of the incompletely evacuated bladder on the development of cystitis and pyelitis, he studied the postoperative histories of a series of 1595 female patients who had been subjected to important surgical operations.

One thousand and fifty-one of these patients, or 66 per cent, required no postoperative catheterization. Of the remaining 544 patients who were catheterized, 11 per cent required artificial evacuation of the bladder once, 5 per cent required the procedure twice, and 17 per cent required three or more

catheterizations. Among the 187 patients, or 11 per cent, who required but one catheterization there were no cases which developed cystitis, but residual urine was detected in 6 per cent for a period of time not exceeding two days. Of the 88 patients, or 5 per cent, who required two catheterizations, 27 per cent showed residual urine thereafter; slight infection occurred in a few cases but promptly disappeared. Of the 269 patients, or 17 per cent, who were repeatedly catheterized 6 per cent showed residual urine for from four to eight days. In these cases the amount of residual urine generally decreased progressively from day to day, vesical symptoms and urinary pus were usually noted for a day or two and then disappeared.

Because of these findings Curtis practices and recommends the avoidance of postoperative catheterization whenever possible, although he does not hesitate to catheterize patients who are really suffering as a result of distention. Curtis advises that whenever it becomes necessary to catheterize a patient once that patient be thereafter subjected to daily catheterizations until free from residual urine; according to this technique the catheter is passed just after each spontaneous voiding. In connection with these catheterizations Curtis[21] advises (1) the use of a boiled catheter (2) cleansing the external genitalia with a weak solution of mercuric chloride, (3) the instillation of a few cubic centimeters of 0.125 per cent silver nitrate solution just before withdrawal of the catheter, and (4) the administration of hexamethylenamine prophylactically in all cases in which the catheter is used. Residual urine of not more than an ounce is considered normal unless it contains pus cells.

Rupture of the bladder does not, of course, occur as a result of distention unless the bladder wall has been previously weakened by disease, and accordingly the principal indication for the use of the catheter postoperatively is the relief of discomfort or pain. If, however, the attitude be adopted that distention is not to be allowed to progress to distention with overflow it would also seem irrational to allow any considerable

amount of distention to occur at all even in the absence of discomfort, otherwise nothing is gained. Accordingly deeply narcotized or unconscious patients should be given special attention and catheterized before any considerable amount of urine has accumulated. Patients requiring repeated catheterization are in any case best put on a regular eight-hour schedule.

Hugh Cabot[22] believes that urine should not be allowed to collect in the bladder postoperatively in an amount exceeding 10 oz. He accordingly believes that instructions should be given to empty the bladder by catherterization at any time after twelve hours providing the patient's sensations are such as to lead the attendant to believe that this amount has been exceeded.

Although, as previously stated, the normal bladder is infected only with difficulty, carelessness in the performance of catheterization should not be encouraged on this account, but rather nurses and attendants should be constantly impressed with the seriousness of contamination in connection with this procedure and the necessity of developing and maintaining a scrupulously aseptic technique.

2. *Treatment of Postoperative Cystitis:* In the acute stage of cystitis attention should be directed toward relieving the symptoms of suprapubic distress and frequency and urgency of micturition; a combination of tincture of hyoscyamus and potassium citrate, about 15 grains of the former and 20 grains of the latter, usually furnishes the desired effect when given at intervals of from three to four hours. The diet should be simple and bland, and fluids should be forced. If this treatment does not rapidly give relief resort may be had to codeine or even morphine.

Locally efforts should be directed toward the institution of free drainage of the bladder. If the patient shows no retention of urine, catheterization should be performed once during each twenty-four hours, and before the catheter is withdrawn the bladder should be thoroughly irrigated with a mild anti-

septic solution, saturated boric acid solution being probably the vehicle of choice, although it is highly probable that the mere mechanical lavage of the organ is the important consideration, and the beneficial action of the antiseptic is inconsiderable or even nil. In case the patient shows residual urine catheterization should be repeated every six or eight hours, and lavage should be performed subsequent to each catheterization as just described.

Postoperative cystitis rapidly responds in almost all cases to this form of treatment. As soon as the acute symptoms of the condition have subsided it is customary to prescribe hexamethylenamine and sodium phosphate, but probably forcing of fluid is of much more importance than drug therapy. In cases which do not respond to the treatment as outlined, infection of the upper urinary tract should be suspected.

3. *Catheterization:* Catheters are sterilized by boiling. Catheterization proceeds as follows:

In the case of the female, after the hands have been thoroughly scrubbed, the thumb and index finger of the left hand are used to spread the labia, and the vulva is carefully cleansed, first with soap and water applied by means of a sponge held in forceps and then by means of bichloride of mercury or lysol solution, particular care being taken to cleanse all creases. This may be done most conveniently over a bed pan. The right hand, which previously has come in contact only with the handle of the sterile forceps, is now plunged into the antiseptic solution and then picks up the catheter and introduces it gently into the bladder without allowing it to touch anything but the lining of the urethra.

In the case of the male, the procedure is essentially the same; the thumb and forefinger of the left hand hold back the prepuce while the right is used, first to cleanse the glans and fore skin and later to introduce the catheter.

Catheters pass much more easily if they are suitably lubricated at the tip with sterile lubricating jelly before being introduced. It should be remembered also, of course, that the

urethra of the female is very short (4 cm.), whereas that the male is relatively long (17.5 to 20 cm.).

Not infrequently a patient who has once required catheter-

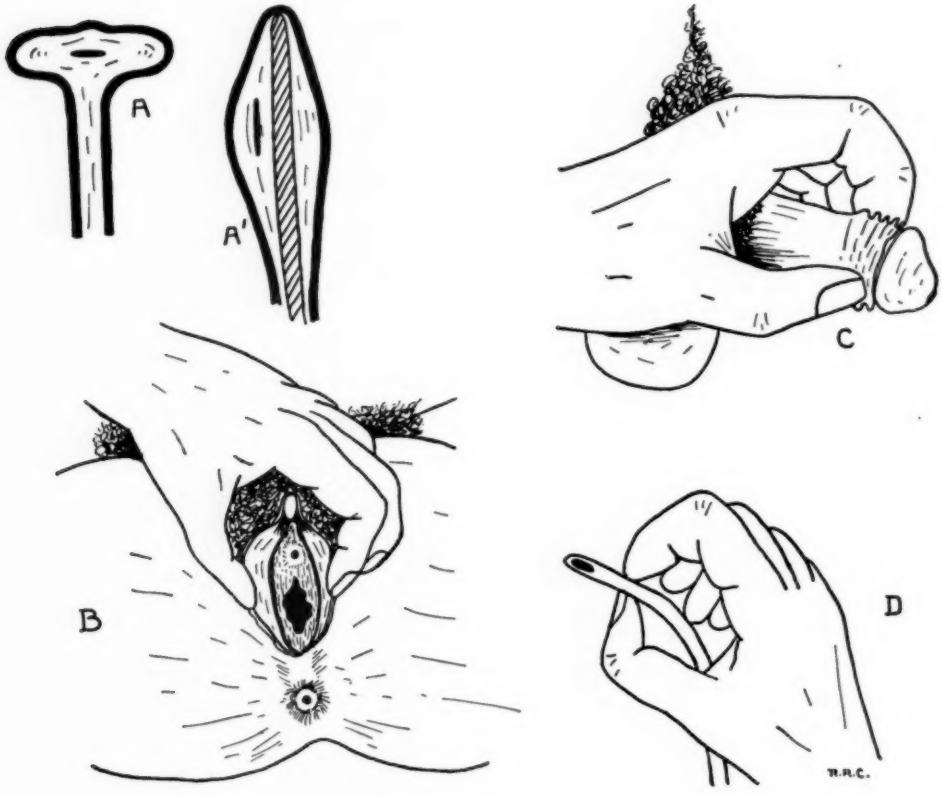

FIG. 47. Some of the essential features of postoperative catheterization. Inserts A and A′ represent cross-sections of a Pezzer catheter, the former with tip of instrument in normal position, latter with mushroom tip stretched and elongated by metal probe passed through instrument from its open end ready for insertion into urethra of female.

Insert B represents proper method of spreading labia in female; this position should be maintained both during preliminary sterilization or cleansing of external genitalia and during actual introduction of catheter.

Insert D illustrates proper method of holding soft rubber catheter between thumb and index finger during introduction of instrument into urethra of either sex.

Insert C illustrates proper method of holding penis of male during processes both of cleansing glans penis and actual introduction of catheter.

ization requires it repeatedly, and much can be done to avoid such a circumstance by instilling into the bladder after catheterization an ounce of sterile glycerine, as suggested by the

late Dr. A. J. Ochsner; this sometimes is of the utmost value in provoking spontaneous voiding subsequently. The instillation of an ounce of 1 per cent silver nitrate solution or an equal amount of 20 per cent argyrol solution at the end of catheterization is an excellent method of prophylaxis against subsequent infection.

In some instances patients who have required several catherizations postoperatively begin to void spontaneously thereafter, and it is accordingly assumed that all is well. Fever and symptoms of frequency and urgency may, however, continue if previously present or may be experienced for the first time if previously absent, and on physical examination the urine may be found to contain pus. In such cases introduction of a catheter will usually discover a large quantity of urine in the bladder, and the explanation becomes apparent: the bladder has been allowed to become unwittingly distended, and the voiding which was judged to be a normal resumption of function actually represented distention with overflow; the overdistended bladder has become devitalized, and cystitis has developed. For this reason, in cases in which peristent difficulty is experienced in emptying the bladder postoperatively it sometimes becomes advisable to make use of the indwelling catheter.

In the female a Pezzer self-retaining catheter is used. The technique of introduction is similar to that used in simple catheterization with the single exception that the catheter must be introduced on a probe, the probe serving the function of stretching the mushroom tip on the end of the rubber tube and thus allowing the manipulation to be made without undue trauma to the urethra (Fig. 47). Before leaving the patient one should ascertain that the catheter is functioning properly; to make sure of this gentle traction is exerted until the button-shaped end has been drawn down into the neck of the bladder. A syringe full of sterile water is then injected into the bladder and it should immediately be discharged from the catheter as soon as the syringe has been disconnected.

In the male a Pezzer catheter should not be used because of the inevitable trauma that would be inflicted during the insertion of such a device; a plain soft rubber or Coudé catheter is preferred in this case.

Postoperative catheterization of patients is usually found necessary in from 12 to 15 per cent of cases. Women require this procedure much more frequently than men, and married women require it more than twice as frequently as single women; consequently, catheterization is much more frequent in gynecological services than elsewhere. Doubtless a condition of relaxed perineum is often responsible for the necessity of catheterization, a condition which is usually associated with chronic vesical distention and which is manifested clinically by a cystocele; thus urinary retention in parous women is frequently the result of degenerative changes in the bladder wall. In nulliparous women urinary retention is frequently of neurotic origin.

Catheterization is required much more frequently in both sexes in connection with those operations involving the pelvic structures or operations upon organs in relation with pelvic organs, such as the appendix, than in other cases, and the incidence decreases markedly for operations on the middle and upper portions of the abdomen. Naturally, as previously stated, packing and other mechanical contrivances used in connection with pelvic surgery are frequently factors in predisposing to the retention of urine, but even in the absence of such mechanical factors urinary retention is more frequent in connection with pelvic surgery than in any other variety. The condition of shock favors urinary retention, as does any condition which depresses the blood pressure and favors a consequent decreased output of concentrated urine. Furthermore, the incidence of retention is greater in those operations accompanied by considerable pain, nausea, and vomiting.

Almost all patients find it difficult and many find it virtually impossible to void in the recumbent position. Many of these will need catheterization as long as they are required to

lie down, and the surgeon is wise who in such cases encourages early spontaneous micturition by having the patient lifted to the sitting position on the edge of the bed or to a standing position if necessary as early as the nature of the operation will permit, and this may be within a day or two in the case of many abdominal operations.

4. *Failure to Void as the Result of Urethral Obstruction:* In the absence of preoperative abnormalities which an adequate preoperative preparation could scarcely fail to reveal, failure of urination as the result of mechanical obstruction to the urethra must obviously be directly dependent upon operative procedures themselves, and as such are usually recognized without difficulty. Such a complication may obviously be expected, particularly in connection with operations involving the urethra, the rectum, the prostate in the male, and the vagina and uterus in the female. Occasionally the cause will be found to be a purely mechanical one such as pressure exerted by an unduly tight packing of the vagina or rectum; sometimes it will be due to the pressure of edema either resulting from direct trauma, or trauma which, exerted primarily outside the urethra, nevertheless spreads to the latter. At all events the condition is easily differentiated from the other causes of failure of urination by the passage of a catheter which on the one hand may become arrested at the site of obstruction, or, on the other hand, overcoming it and progressing into the bladder, will discover urine therein.

The treatment consists prophylactically in avoiding the causes of the condition as far as possible, too tight packings, unnecessary trauma when operating in the region of the urethra, and the recognition preoperatively of strictures which might cause undue trouble during the postoperative period. Active treatment consists of a rectification of the pathology; when caused by edema, the application of moist heat to the part is indicated either indirectly by way of the perineum in the form of hot moist compresses or hot water bottles, or directly by hot douches in the female or rectal flushes in the male. Catheter-

ization is of course necessary to empty the overdistended bladder and suprapubic cystotomy would be required in a desperate case. By and large, this particular complication is mainly associated with surgical specialities, urology, gynecology, and can be dismissed briefly here.

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Chapter XI

POSTOPERATIVE PULMONARY COMPLICATIONS

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Chapter XI

POSTOPERATIVE PULMONARY COMPLICATIONS

The subject of postoperative pulmonary complications is one in connection with which many differences of opinion exist. The experimental work which has been done on the subject is comparatively voluminous but, most of what is known concerning it is based on collections of clinical observations supplemented in many cases, it is true, by skiagraphic and other studies, but usually susceptible of many interpretations depending to a certain extent, at least, upon the inclinations of the interpreter.

All forms of clinical pulmonary complications may follow an operative procedure, pleurisy, abscess, gangrene, pneumothorax, atelectasis, bronchitis, infarction, embolism, pneumonia.

1. General Incidence of Pulmonary Complications

Lemon[1] estimates that 1 in every 50 patients operated upon may be expected to develop one or another type of postoperative pulmonary complication and that 1 patient out of every 185 will die as a result of such complication; he states that deaths from pneumonia alone following all types of operation average 9.5 per cent, whereas the morbidity rate averages 1.1 per cent for general surgery and 4.4 per cent for laparotomies.

The estimations of Cutler and Hunt[2,3] are approximately the same; they estimate on the basis of 18,075 collected cases that 2 per cent of patients operated upon for any reason, 4 per cent of patients in laparotomy cases, and 8 per cent of upper abdominal operative cases develop such complications. McKesson,[4] in 1918, found 3.03 per cent of lung complications in 39,438 cases. Males suffer from these complications more frequently than females, 2 to 1 (Whipple[5]) or 3 to 1 (Cleve-

land[6]); Featherstone[7] estimates the ratio between the sexes in *stomach* cases as high as 4 to 1.

Pulmonary complications follow abdominal operations much more frequently than other varieties of operations as shown by the figures of Gwyn[8]; pulmonary complications subsequent to abdominal and pelvic operations, 102; subsequent to operations elsewhere in the body, 8. Similarly, Sise,[9] in 1927, reporting on 3559 operations, concluded that the incidence of lung complications is lowest in operations on the extremities, head, and neck (0.5 per cent), much higher in operations upon the abdomen (lower abdomen 1.0 per cent), especially the upper abdomen (10.0 per cent).

Judging from such statistics as are available the incidence of postoperative pulmonary complications has been somewhat on the increase during the past quarter of a century.

Year	Author	Hospital	No. of Cases	Per Cent of Morbidity
1906	Armstrong[10]	Montreal General	2,500	2.12
1908	von Lichtenberg[11]	(Collected)	23,673	1.9
1908	Ranzi[12]	Eiselberg's Clinic at Vienna	6,871	3.8
1910	Beckman[13]	Mayo Clinic	3,657	1.12
1912	Beckman[14]	Mayo Clinic	5,835	1.57
1913	Beckman[15]	Mayo Clinic	6,825	1.27
1917	Cutler & Morton[16]	Mass. General	3,490	1.86
1918	McKesson[4]	(Collected)	39,438	3.03
1920	Cutler & Hunt[2]	Peter Bent Brigham	1,562	3.52
1921	Cutler & Hunt[3]	Peter Bent Brigham	1,604	3.92

In all probability, however, the increasing incidence is more apparent than real and represents actually an increasing vigilance in the recognition of the minor degrees of pulmonary complications previously overlooked.

II. Mechanisms of Development

Three general mechanisms have been suggested as explaining the manner in which postoperative pulmonary complications become established:

1. The aspiration theory
2. The embolic theory
3. The theory of lymphatic extension

To these may be added a fourth:

4. The theory of atelectasis, which represents not a single mechanism, but rather a combination of several factors at present not particularly well known.

The theory of lymphatic extension may be dismissed very briefly, since it is fairly well established that such a theory cannot be conveniently invoked to explain that very large group of cases in which pulmonary complications ensue after operations on the upper respiratory tract, the lymphatic drainage of the oral cavity and of the neck being quite independent from that of the thorax. Most authorities at the present time are agreed that the hypothesis of lymphatic extension has little evidence in its favor.

There has been for a number of years, and there still continues to be, a rather ardent controversy over the relative importance of aspiration and embolism in the causation of postoperative pulmonary complications.

The earlier pulmonary complications follow so closely upon the administration of anesthetics in cases subjected to general inhalation anesthesia that almost from the time of the birth of anesthesia the anesthetic agent has been incriminated to some extent at least as the causative factor; formerly it was customary to speak of an "ether pneumonia" which was thought to be a particular kind of inflammatory reaction dependent solely upon the irritative action of the ether vapor inspired during the course of the anesthesia. It has been fairly conclusively demonstrated, however, that ether vapor *per se* is incapable of producing the tissue changes commonly found in this type of pneumonia; ether vapor alone apparently produces only a rather transient hyperemia accompanied by excessive mucous secretion. The aspiration theory, as at present understood, therefore, refers not to the aspiration of irritating anesthetic vapors as such but rather to the aspiration

of foreign material, blood, mucus, and pus, an accident facilitated by the unskilful induction of anesthesia.

Aspiration in this sense is held by many authorities to be the essential feature in the production of postoperative pulmonary complications; probably just as many other authorities accept the embolic theory.

A. ASPIRATION THEORY: In connection with the aspiration theory it is fairly well established at present that during inhalation anesthesia material from the mouth, mucus, mixed with blood in cases of operations on the upper respiratory tract, is characteristically aspirated into the tracheobronchial tree to a greater or lesser extent depending upon two factors, (1) the depth of the anesthesia, and (b) the position of the patient.

1. *Depth of Anesthesia:* Myerson[17] examined bronchoscopically 100 patients who had undergone tonsillectomy under light ether anesthesia. He found that 18 per cent of those in whom the anesthesia was so light that it did not abolish the cough reflex had aspirated mucus and blood below the level of the larynx, whereas 90 per cent of those cases in which the cough reflex had been completely abolished showed mucus below the level of the trachea.

2. *Position of the Patient:* Lemon[1] by the use of gentian violet, India ink and certain substances opaque to the *x*-rays showed in dogs that the position of the animal was of the utmost importance in preventing aspiration under general anesthesia. He found that the danger of such aspiration was much greater when the animal was placed in Fowler's position than when placed in the Trendelenburg position, the extreme Trendelenburg position obviating such aspiration completely. This author also showed that the danger of aspiration was markedly increased in cases in which the anesthesia was maintained at a level such that the animal struggled, breathed stertorously, swallowed, or vomited.

B. EMBOLIC THEORY: The condition of gross pulmonary embolism has been recognized for many years and will be

discussed at greater length subsequently. The embolic theory of pulmonary complications, on the other hand, postulates a condition of minor embolism upon which more extensive pathological changes become subsequently engrafted.

The condition of minor embolism as a postoperative complication was first suggested by Mikulicz[18] in 1900. That the significance of such a condition was not previously recognized is doubtless entirely due to the fact that it is difficult to differentiate at autopsy between areas of pneumonia, the fundamental basis of which is an embolism, and areas of pneumonia arising from other causes. Cutler,[3] following Mikulicz's lead, and later Schleuter, Weidlein, Holmans,[19,20] and others have advanced and presented evidence to substantiate the theory that the large majority of postoperative pneumonic conditions, which formerly were considered due to infection of the lung through the respiratory tract as the result of the action of anesthetics, are actually embolic in origin. Cutler and his school have been able to demonstrate that it is virtually impossible experimentally to produce pulmonary infections by the aspiration route, i.e., as a result of the implantation of ordinary pathogenic bacteria into the tracheobronchial tree, whereas such is easy as the result of the introduction of infected emboli into the blood stream.

Against the embolic theory as the usual cause of postoperative pulmonary complications, however, at least three different lines of reasoning have been urged:

First: As Smith[21] has recently demonstrated, it is perfectly possible to produce pulmonary abscesses in mice, guinea pigs, rabbits, and dogs by intratracheal inoculation of bloody material obtained from the region about the teeth of patients suffering from pyorrhea. In his experiments 50 per cent of the animals died of pneumonia, and 20 per cent developed pulmonary abscesses.

Second: When postoperative pulmonary lesions are examined bacteriologically it is customary to find two or more of the following organisms in the lesion: spirochetes, fusiform bacilli, cocci, and vibriones, organisms which occur characteristically in the tonsillar crypts and about the teeth. This is

strongly suggestive of the possibility that aspiration plays a pretty important rôle in the production of these postoperative pulmonary complications.

Third: As is well known, in embolic processes such as occur in conditions not associated with surgery, for example, in the pulmonary infarction of typhoid fever, pain and hemoptysis are outstanding symptoms, symptoms which are almost never present in cases of pulmonary complications arising in connection with operative procedures.

C. ATELECTATIC THEORY: The graver degrees of atelectasis known as massive collapse have recently become well recognized clinical entities. The minor degrees of the condition, however, have become increasingly emphasized as a more definite knowledge of the underlying mechanics of the condition has been developed.

Mastics, Spittler, and McNamee[22] have estimated that over 70 per cent of all the so-called postoperative and postanesthetic pneumonias really represent a condition of atelectasis of varying degrees. Lee, Tucker, and Clerf[23,24] have expressed the opinion "that the phenomena of pulmonary collapse of varying degrees, together with pulmonary embolism and infarction, are the real etiological factors in postoperative pulmonary complications."

Atelectasis is conveniently described by the advocates of the atelectatic theory in three degrees:

1. *Massive atelectasis* which involves more than one lobe of the lung,
2. *Lobar atelectasis* which involves a single lobe of a lung,
3. *Lobular atelectasis* which involves scattered areas in one or several lobes.

The first, or massive atelectasis, may easily be mistaken for pleural effusion, empyema, or pneumothorax; the second is characteristically misdiagnosed lobar pneumonia; and the third is not infrequently mistaken for bronchopneumonia or pulmonary infarction.

That atelectasis is not peculiarly a postoperative phenomenon is attested by the fact that it has been recognized in a variety of conditions, such as (a) in non-penetrating wounds

of the thorax and abdomen, as well as (b) in injuries of the lower extremities, (c) in conditions of increased intra-abdominal tension, such as occur in intestinal obstruction and peritoneal effusion, (d) in association with tumors, (e) in connection with pharyngeal diphtheria, (f) in connection with foreign bodies lodged in the trachea and bronchi, and (g) also as a spontaneously occurring lesion.

Lee, Tucker, and Clerf[24] believe that two fundamental factors are involved in the production of atelectasis:

(1) the presence of a thick, viscid, bronchial secretion, and

(2) some inhibition of coughing.

They believe that because of the character of the secretion and the inability or disinclination of the patient to clear it from the bronchi by coughing, it accumulates in the bronchial tree until it finally completely obstructs the lumen at some point. Such an occurrence developing in a small bronchiole produces a lobular atelectasis, in a primary bronchus leading to a lobe a lobar atelectasis, and, in a main bronchus of either lung a massive atelectasis. Masses of thick, tenacious, viscid, bronchial secretion are sometimes found clinically and may be removed under favorable circumstances through a bronchoscope, a procedure which gives varying degrees of relief, depending probably upon the amount of time which has elapsed between the onset of the atelectasis and the institution of this measure for its relief.

Lee, Tucker, and Clerf[24] have succeeded in producing experimentally in the dog an atelectasis resembling in all points that characteristically seen as a postoperative complication in human beings by introducing mucous material derived from a clinical case of atelectasis into the bronchus of the animal, subsequently narcotizing the animal in such a way as to abolish the cough reflex. Lee, Ravdin, Tucker, and Pendergrass[25] believe that experimental atelectasis may be produced in animals by the use of any substance similar in physical properties to the viscid sputum characteristically found in cases of atelectasis, provided that only the cough reflex be

abolished. They have successfully used solutions of gum acacia for the purpose.

III. General Characteristics of Postoperative Pulmonary Complications

Postoperative pulmonary infections differ from the ordinary infectious lung disorders in several particulars: (1) their onset is not accompanied by either chill or pleural pain, (2) they are only rarely associated with herpes labialis, (3) neither serous nor purulent effusions tend to accompany or follow them, and (4) the temperature and pulse rate rise very rapidly, becoming maximal within a very few hours.

IV. Clinical Classifications

Probably no entirely satisfactory classification of postoperative pulmonary complications is possible at the present time. However, in order to discuss the subject at all some classification must be undertaken, and the one herewith proposed seems essentially correct.

A. Pneumonia: Lobar pneumonia, bronchopneumonia, and bronchitis have been recognized as the most frequent respiratory complications following operations performed under general anesthesia and may be discussed together as representing the clinical entity "postoperative pneumonia."

This complication must be divided clinically into two subclasses, (1) the so-called "early pneumonia" which is an accident connected immediately with the operation, and (2) the so-called "late-pneumonia," the symptoms and signs of which develop at the end of from forty-eight to seventy-two hours or longer.

1. *Early Pneumonia:* Early pneumonia is also called "aspiration pneumonia," "ether pneumonia," "postoperative bronchopneumonia," and "surgical pneumonitis," and is the most frequent type of complication encountered. It develops within a few hours of operation, often within twelve hours, and presents a progression of symptoms and signs similar, within

the previously mentioned general limitations, to those of an ordinary bronchitis or a lobular pneumonia. The rapidity of onset of the symptoms, the absence of pleural pain, the seasonal variation in incidence which is seen in this group, and the fact that almost all of the cases develop after ether anesthesia suggest that irritation of ether vapor and aspiratory infection are important etiological factors in these cases. This type of complication is particularly prone to develop, therefore, in patients who have "taken" a general anesthetic poorly, in whom relaxation has been incomplete, who have vomited, and who have presented stertorous and labored breathing. Postoperative chilling may often play a part in the etiology.

Symptoms and Signs:

1. The temperature rises to from 101° to 105°F. without chill.

2. The breathing is rapid and shallow and is usually accompanied by exaggerated excursion of the upper part of the thorax.

3. Pain is absent.

4. The pulse is rapid and weak.

5. Cough is unproductive at first and unaccompanied by physical signs; later the cough is productive of purulent phlegm, and coarse scattered râles are heard; areas of bronchopneumonia may be found in both lungs at the bases.

The duration is from nine to ten days, during which the fever resolves by lysis. Empyema and lung abscess are not frequent complications. The mortality ranges between 20 and 60 per cent.

2. *Late Pneumonia:* The frequent time of occurrence of late pneumonia is from the eighth to the twelfth day postoperatively, but it may be observed from the second day to the third week. The interval between operation and the development of the complication is usually not entirely afebrile (about 1° of fever is noted), a circumstance which has been interpreted as indicating that this variety of pneumonia develops on the basis of infarction.

Symptoms:

1. Sudden onset occurs with pain in the chest, usually without chill.

2. The breathing is shallow and rapid.

3. Cough is painful; about one-third of the cases have blood-tinged sputum.

4. Fever is moderate, 102° to 104°F., and characteristically of the septic type.

5. "Friction rub," diminished breath sounds, and localized dulness to percussion occur early, usually in the lower lobe of the right lung.

6. *X*-ray findings are those of lobular consolidation.

Except in aged patients and in those debilitated from other causes this type of infection is not of serious prognosis as regards life, there being virtually no mortality, but it constitutes an added strain, especially unpleasant in laparotomies. Whipple[5] and Cleveland[26] have apparently demonstrated that such cases of pneumonia are almost always due to the type IV pneumococcus; the other types of pneumococcus when they are the causative organisms tend to produce a type of pneumonia much more closely simulating ordinary lobar pneumonia. This type of complication may occur after either local or general anesthesia; it occurs after abdominal, pelvic, or nose and throat operations. It is occasionally accompanied or followed by empyema or lung abscess.

B. Treatment of the Early and Late Pneumonias: The successful treatment of both the early and late pneumonias depends largely upon (1) recognizing the infection early, (2) careful nursing, (3) providing the patient with an abundance of oxygen, and (4) symptomatic treatment of the cough.

In providing oxygen advantage should be taken of any feasible opportunity to get the patient into the open air. Formerly it was customary to move the patient's bed to a porch or covered roof even in very cold weather and there to leave the patient, suitably protected, of course, from draughts by screens, in any but the most inclement weather. Many

internists at present believe such treatment to be too drastic in cold weather but that the "open air" treatment is quite suitable in warm weather all are agreed. In any case ample ventilation should be provided.

Since adequate ventilation of the lungs is hampered by the effect of gravity in the recumbent position, the patient should be propped upon a back-rest if at all feasible, and such a position may usually be maintained comfortably and without danger if a little ingenuity be exercised in the placing of pillows and in the improvisation of "slings" to relieve tension on the patient's muscles.

In the severer cases the administration of artificially prepared oxygen is of value in lowering the temperature, promoting the patient's comfort, and favoring his eventual recovery. The invocation of this measure should not be delayed until the situation has become desperate, because in such cases it is often of very little value.

Of course, an oxygen chamber is an excellent device, if such a chamber be available, but the installation of such a device involves a considerable financial expenditure, and accordingly an oxygen chamber is not often available. The lack of special equipment of this kind is not a very serious drawback, however, since a simple oxygen inhalation apparatus can be improvised readily for use almost anywhere. Many suitable varieties of apparatus have been devised. All that is necessarily required is an oxygen tank and a wash-bottle provided with a two-holed stopper, an entrance and exit tubes, an ordinary catheter, and some lengths of rubber tubing. The wash-bottle is partly filled with water; the catheter is passed through the nose well back into the nasopharynx of the patient and is fastened in place to the cheek by means of adhesive plaster; the release valve of the oxygen cylinder is now turned until bubbles of oxygen traverse the water in the wash-bottle in rapid succession but do not form a continuous stream (about 120 bubbles per minute) (Fig. 48). The concentration of oxygen (about 30 per cent by volume) which

can be supplied by such a device is not nearly so high as that obtainable in an oxygen chamber, but the results obtained by the method are usually quite satisfactory.

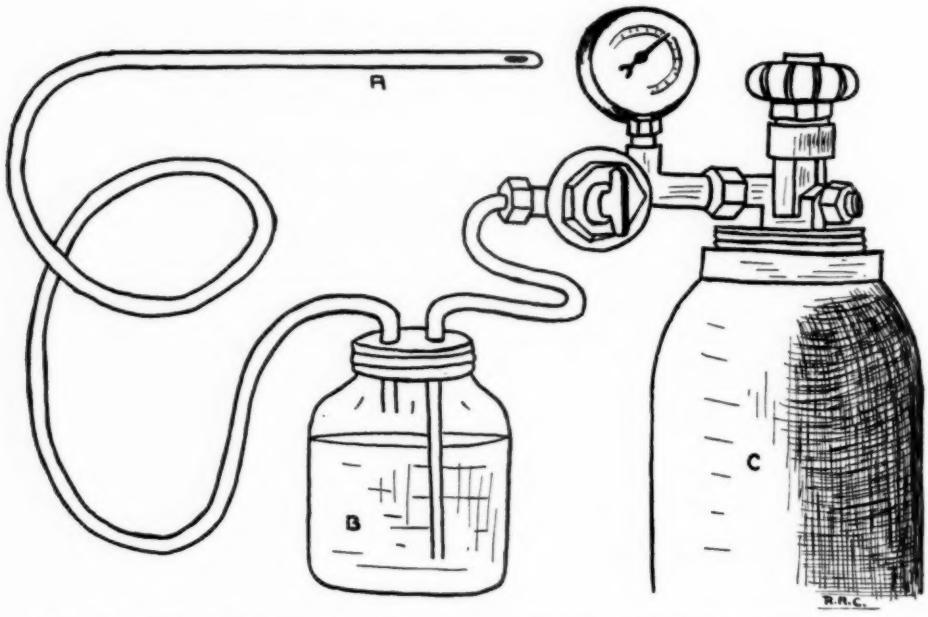

FIG. 48. Simple and reasonably efficient type of apparatus for the administration of either oxygen or carbon dioxide when regular anesthetic machines are not available. "A" is a rubber catheter which is introduced through the patient's nose into the nasopharynx. "B" is a wash-bottle partly filled with ordinary tap water and provided with a long entrance and a short exit tube. "C" is an oxygen or carbon dioxide tank as the case requires; it is provided with a gauge which shows the amount of pressure within the tank and an adjustable release valve. In operation the release valve is turned until bubbles of gas escape through the wash-bottle; the amount of gas can be roughly calculated by noting the rate of bubble formation. About 120 bubbles per minute is the average rate of flow when administering oxygen.

Pulmonary complications other than the pneumonias commonly ensue after four or five days and are most probably embolic in nature; they are not infrequently associated with femoral thrombophlebitis.

C. PULMONARY INFARCTION AND EMBOLISM: Etiologically infarction and embolism are closely related entities since both are embolic phenomena, the essential difference consisting in the relative size of the emboli.

1. *Thrombotic Infarction:* By pulmonary infarction is meant the series of organic changes and the train of clinical symptoms and signs occurring as the result of the dislodgment of a small

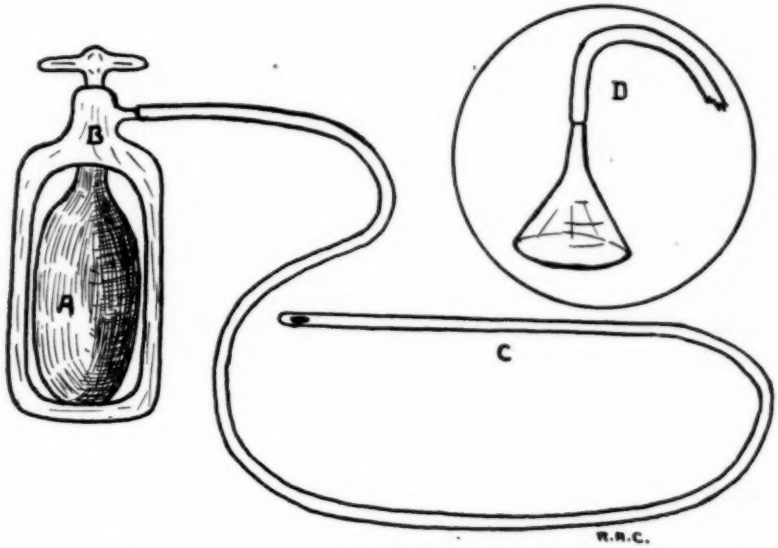

FIG. 49. A very simple and inexpensive apparatus for the emergency administration of carbon dioxide. "A" is a carbon dioxide cartridge such as is sold by the dozen commercially for carbonating water in siphon bottles for beverage purposes; it contains about 5 gallons of compressed gas. "B" is a perforator which serves the functions both of releasing the gas and regulating its flow. "C" is a rubber catheter which is introduced into the nostril of the patient. The catheter should not be introduced very far into the nose when this apparatus is used because the flow of gas cannot be controlled very accurately, and overdosage is to be avoided. The apparatus can be made to terminate in a glass cone or funnel as shown at "D" if desired. This apparatus is so compact that it occupies but little room in a surgeon's handbag.[1]

embolus or of a number of small emboli, not large enough to occlude the arterial blood supply of an entire lobe, yet large enough to interrupt the blood supply to a part of a lobe of the lung. The clinical manifestations consist of sudden sharp pain in the chest, elevation of temperature, increase in pulse rate, dyspnea, cough and hemoptysis, accompanied by the development of friction rubs, râles, local impairment in percussion note, changes in breath sounds, and sometimes, in the severer cases, cyanosis and shock. The usual type of case presents the following features:

[1] Hewer, C. L. The therapeutic value of carbon dioxide. *China M. J.*, 41: 852, 1927.

Following the performance of a clean operation there ensues a period of from three to eight days of moderate fever, 100° to 103°F., for which no adequate explanation can be found; this, in turn, is followed by from one to twelve days of normal temperature, rarely more, and following this occurs acute pleural pain, the development of pleural friction rubs, and a recrudescence of the fever. Often associated with the chest condition, or occurring shortly after it, there are symptoms and signs of a femoral thrombophlebitis; not improbably in cases which do not show femoral thrombophlebitis and which present a similar type of history the pulmonary process is secondary to a silent phlebitis elsewhere, possibly often in the abdominal veins, particularly the pelvic veins. The explanation for the sequence of symptoms and signs is not far to seek; the initial febrile period is due to the formation of a thrombus in a vein and subsequent absorption of the blood clot; the ensuing afebrile period represents the period during which the thrombotic process is stationary, no more clot being laid down and no attempt at reabsorption yet having occurred. The pleuritic attack and febrile reaction represent the period of softening and absorption of the clot during which time particles break off from the main mass as emboli, are taken up by the circulation and lodge in the lung.

2. *Thrombotic Embolism:* By embolism is meant the anatomical changes and the clinical manifestations following the lodgment in the lung of an embolus of sufficient size to occlude the main trunk of the pulmonary artery or one of its principal branches.

Cases falling within this classification are almost always associated with thrombosis of the pelvic or femoral veins and according to common belief characteristically complicate operative procedures in the lower abdomen, such as hysterectomies and the removal of pelvic tumors, though such statistics as are available fail to substantiate the emphasis on lower abdominal surgery.

a. Incidence of Thrombotic Embolism: Vietor[27] collected 21 fatal cases of thrombotic embolism from 12,615 operative cases at the New York Hospital covering the ten-year period from January 1, 1915 to December 1, 1924. The average time of occurrence was thirteen days after operation; the shortest postoperative time interval was sixteen hours, and the longest was forty-seven days. Heard,[28] quoting statistics from

the Mayo Clinic from 1912 to 1920, reported 104 fatal cases in a series of 125,164 operations. Hampton and Wharton[2] reported 21 cases in 21,000 postoperative gynecological patients, of whom 19 died. Rupp[30] published a report of 59 cases of embolism occurring in 22,689 operations. Reports from the German literature by Oberndorfer[31] and Detering[32] indicate that the incidence of postoperative thrombosis and embolism has noticeably increased since the World War. Five cases of embolism have been reported following the injection treatment of varicose veins in a series of 53,000 cases.[33]

b. Etiology: Various theories have been propounded to account for the formation of the thromboses which produce thrombotic embolism. Four factors are usually mentioned as predisposing causes: (1) sepsis, developing at the site of operation and producing septicemia or extending from the site of operation and involving the veins by continuity, (2) liberation of thrombokinase from the operative wound, (3) local trauma of small veins at the site of operation as by unduly powerful retraction, and subsequent spread of the thrombotic process from these veins to the external iliac or femoral veins, and (4) stasis in the large veins, due to a variety of causes, loss of fluids by purging, vomiting, and hemorrhage, the effect of posture of the patient during and subsequent to operation and depressions of the blood pressure due to hemorrhage, shock, or prolonged narcosis.

Of these various factors only the last seems to be supported by very conclusive evidence. Lister,[34] reporting statistics on 195 cases of postoperative thrombotic embolism from the Pathological Institute of the London Hospital, argues that if sepsis were an important factor appendicitis should be complicated by thrombotic embolism much more frequently than it is; if liberation of thrombokinase were an important factor extensive operative procedures like radical amputation of the breast and nephrectomy should be more frequently thus complicated than statistics show, and if powerful retraction of

wounds were of important etiological significance statistics should indicate the fact.

Lister[34] after a very careful analysis of his cases was able to show that only two factors are of definite significance, (1) the age of the patient and (2) laparotomy incisions. In his cases the incidence of the condition was found to increase for every decade of life from the first to the seventh. The influence of abdominal incisions was very striking, about the only other surgical condition besides laparotomy which contributed any cases being fracture of the femur. Because of these latter findings he believes that the fundamental factor in the causation of thrombosis is venous stasis due to deficient muscular action, and he argues that incisions into the abdominal wall tend to produce the condition by decreasing the respiratory movements, thus interfering with the intra-abdominal and intercostal pressure relationships, whereas fractures of the femur interfere directly with free venous flow through the lower extremity because they inhibit the massage-like action of the muscles of the thigh.

c. Clinical Characteristics: Thrombotic pulmonary embolism develops unexpectedly and suddenly in postoperative cases and usually results fatally. It is believed, following Aschoff's[35] teaching, that the thrombotic emboli which produce pulmonary embolism always arise either from the femoral vein or from the pelvic veins; the latter source is probably of very minor importance. The conformation of clots removed from patients dying of postoperative embolism usually indicates the source as the femoral vein. Occasionally fatal pulmonary embolism may occur without the slightest warning, i.e., it may not be preceded by symptoms of a preexisting phlebitis or thrombosis. At autopsy the source of the embolus may or may not be apparent, even when the autopsy is performed with the utmost care. Bernheim[36] has suggested that in many such cases the thrombotic process originates in the great veins of the neck.

Cases of thrombotic embolism may sometimes present the same clinical course as the preceding group (1) a febrile stage due to thrombosis, (2) an afebrile period of quiescence, and (3) the acute attack of thrombotic embolism. The clinical attack is relatively more severe than in cases of infarction, since the embolus concerned is larger, and the prognosis is more grave, the process either killing in a relatively short period of time or at best putting the life of the patient in jeopardy for some hours. Fatal embolism occurs as a complication of frank phlebitis but rarely according to Vietor,[27] Brown,[37] and Rowntree,[38] and Miller and Rogers[39] found only a 2.5 per cent association of phlebitis and embolism in 206 cases.

This complication usually ensues during the first or second postoperative week; the patient, who is often sufficiently convalescent to be up and about, suddenly develops a feeling of faintness, often accompanied by either precordial pain or a sense of tightness across the chest, incontinence of urine and feces may occur, and the patient usually feels faint and sinks to the floor. The onset characteristically occurs during some act of physical exertion, such as the first attempt at walking after the patient has been in bed for some time, straining at stool, or getting in or out of the bathtub. On examination dyspnea is characteristically marked, the face is cyanotic and wears an anxious expression, cold sweat is often present on the forehead, the pulse is rapid and weak, and the extremities are cold and clammy. There may be hemoptysis.

Usually death follows in from five to twenty minutes regardless of the combative therapy employed. Of 233 cases of pulmonary embolism collected by Lenormant 106 proved fatal,[40] but Heard,[28] collecting the statistics from the Mayo Clinic from 1912 to 1920 and covering 125,164 operations, reported only 5 recoveries in 104 cases; such reports, coupled with the relative incidence of postoperative pulmonary embolism as given by these authors (0.5 per cent as reported by Lenormant and only 0.08 per cent as reported by Heard) seems to indicate that possibly some of the cases reported

by the former author may not have been true pulmonary embolism; 99 of the 104 cases reported by Heard were proved at autopsy, but possibly certain patients who recovered or on whom an autopsy was not performed were overlooked by this author, so that possibly Heard's figures err in the direction of conservatism.

Cases of pulmonary embolism may be divided conveniently into three groups according to the ratio between the involved and the uninvolved portions of the lungs:

Group I, in which a relatively considerable portion of the pulmonary circulation is obstructed, death following rapidly in these cases.

Group II, in which death follows somewhat less rapidly, or in mild cases the patient recovering, only a relatively small part of the pulmonary circulation being involved, and

Group III, in which death does not occur for some days (two to three), the original embolic process involving only a small portion of the pulmonary circulation, but the process being progressive because of a superimposed thrombosis originating at the point of embolism.

d. Prophylactic Treatment: It is highly unfortunate that the etiology of thrombotic embolism is so incompletely understood, since in a process so fatal, and so rapidly fatal in the bargain, really the only treatment that is effective in the vast majority of cases is the prophylactic treatment of the underlying thrombosis, and this, in turn, cannot properly be applied in the absence of an understanding of the etiology. As previously stated it would seem that thrombolic pulmonary embolism following operative procedures is virtually non-existent except in those cases in which the abdomen has been opened, and consequently prophylactic measures become a matter of concern only in cases of laparotomy.

Most authorities are agreed that in the absence of more evidence then is at present available one cannot afford to overlook any of the factors that might possibly be responsible for the condition. They recommend the reduction of operative

vascular traumatism to a minimum, since injury to the venous channels almost certainly favors thrombosis, and this, in turn, may give rise to the development of an embolus by the breaking off of a portion of the blood clot contained within the vessel. It has been suggested also that in a certain number of cases embolism may be dependent upon enforcement of the dorsal decubitus position, a position which favors thrombosis by slowing the general circulation, and accordingly many from this consideration alone favor reasonable changes of the patient's position in bed during convalescence in all but those few cases, mainly cases of grave general peritonitis, in which such changes of position would prove dangerous. Local tissue trauma and infection, as well as any condition such as the presence of a tumor, which slows the circulation locally, also presumably favor thrombosis, and any of these factors which can be alleviated should receive the attention of the medical attendant as a prophylactic precaution.

Because of the fact that certain cases are engrafted upon a condition of femoral thrombophlebitis various authors, following the lead of Whipple,[5] have advocated the early postoperative institution of passive massage or active systematic exercises of the lower extremities in order to overcome any tendency to local venous stasis. Such exercises usually take the form of bicycle riding movements performed while the patient lies in dorsal decubitus.

Waters[41] advocates the postoperative use of thyroid extract in doses of 2 grains three times per day on the theory that by increasing the metabolic rate the blood-pressure and rate of blood flow may be increased.

It would seem on theoretical grounds that dehydration should predispose to thrombus formation, and consequently a prophylactic measure of value would seem to be the administration of adequate quantities of fluid. Avoidance of shock and hemorrhage is of axiomatic importance.

Following the lead of Lister[34] it would seem that measures designed to maintain normal respiratory movements are of the greatest importance.

The active treatment, once pulmonary embolism has developed, is in many cases nil, since death occurs too rapidly. In those patients who survive for a sufficient length of time, however, the first indication is to support respiration by elevating the patient to the sitting position and to supply oxygen if the condition seems to warrant this therapy and if oxygen is available. The peripheral circulation is supported by the application of heat to the periphery of the body most conveniently in the form of hot water bottles; venesection may possibly be of some value in selected cases to relieve embarrassment of the right side of the heart. Morphia may and should be given to counteract shock, and such methods of rapid stimulation of the respiratory and circulatory centers by drugs as may be thought to be of value may be employed. Trendelenburg's operation, which consists in evacuation of the blood clot from the pulmonary artery, may prove of life-saving value occasionally and should be kept in mind as a possibility, though usually neither the case nor the circumstances are favorable for the successful performance of this procedure. The literature contains the records of a number of cases in which this particular operation has been adopted sometimes successfully and sometimes unsuccessfully. Meyer[42,43] reported 2 cases of which only 1 was successful. Nystrom[44] reported 3 cases, only 1 of which was successful; de Harven[45] had 3 cases, all fatal; and Crafford[46] 2 cases, both successful. The latest report by Westerborn[47a] states that 16 cases have now been recorded in the literature, 7 of which were definitely cured whereas the remaining 9 patients survived the operation but a short time. The value of the procedure in any case is open to question since it cannot be determined whether or not the successful cases would have recovered anyway even had the operation not been invoked.

3. *Fat Embolism:* a. Etiology: The blood stream normally contains a certain amount of neutral fat which, however, even in digestive lipemia, in which condition the normal content is greatly augmented, is so finely divided that the particles do not become visible when treated with fat stains. Fat embolism cannot occur as a result of the presence of such a fine emulsion. Only when conglomerations of fat of comparatively large size find their way into the circulation or are formed within the circulating blood by a process of agglomeration can symptoms arise. The symptoms are due to blockage of terminal radicles of the vascular tree by fat globules so large as to produce local or generalized circulatory embarrassment.

According to the usually accredited conception, fat embolism is a condition which arises only as a complication of surgical or other severe traumata. It is caused by the ingress of liquid fat into the blood stream. The fat usually finds its way into the circulation through the lumen of a ruptured blood vessel, but may possibly under exceptional circumstances be discharged into the circulation through the thoracic duct. The fat is derived from the patient's own tissues, and consequently there is always danger of fat embolism, in any case in which the traumatized area is rich in fat, like the marrow of the long bones in fractures and the panniculus adiposus of obese individuals in abdominal surgery; in short, fat embolism becomes a possibility whenever the fat reservoirs of the body are traumatized sufficiently to produce an uninterrupted communicating passageway between globules of tissue fat and the venous radicles of the vascular tree. Because of the rigid structure of bone it is supposed that the blood vessels in the osseous tissues are more apt to remain patulent and that fat embolism thus becomes an especial danger in cases of both accidental and surgical trauma to bones.

Largely as a result of the researches of Lehman[47] and his co-workers, however, this hypothesis seems at present to be in need of certain revisions. Many investigators have noted the occurrence of fat embolism in a variety of non-surgical and

non-traumatic cases coming to autopsy, specifically in cases of cardiovascular-renal disease, burns, postinfluenzal pneumonia, eclampsia, diabetes, phosphorus poisoning, and acidosis, and occasionally in many other conditions, such as profound sepsis, chronic alcoholism, acute pancreatitis, splenitis, sarcomatosis, and carcinomatosis.[47] It seems probable that in such cases some other mechanism beside discharge into the blood stream of free fat from the fat reservoirs of the body must be operative. Furthermore, as has been appreciated for a long time even in cases of trauma the amount of fat occurring in fat embolism, as demonstrated at autopsy, is frequently out of all proportion to the amount which might reasonably be expected to be derivable from the area traumatized. The possibility of the occurrence of agglomeration of emulsified particles of fat normally circulating in the blood stream has, therefore, been investigated. It has been shown that the prolonged administration of ether during the lipemic stage of digestion of a fatty meal is capable of producing fat embolism. Apparently the mechanism is one in which emulsified particles of fat coalesce to form macroscopic globules. Furthermore, in the test tube, at least, crushed muscle, hemoglobin, and histamine have been found capable of producing just such a phenomenon; all three of these substances, of course, may very easily find entrance into the blood stream. Possibly the most convincing link in the chain of evidence, however, is the experimental finding that dogs tolerate without showing symptoms the artificial introduction into the blood stream of an amount of fat which, weight for weight, is considerably greater than could possibly be freed in the human being by fracture even of the femur.

It is believed by some authorities that the condition of fat embolism is of relatively frequent occurrence, but that the condition is usually of a degree so minor as to be clinically recognizable but seldom. In line with this conception Lehman and his co-workers[47] have ventured the hypothesis that many of the cases of postoperative pneumonia are fundamentally

due to a process of fat embolism. They have found marked scarring of the lung in post-mortem examinations performed some time after the production of fat embolism, a histopathological picture which corresponds very closely with that found in late cases of bronchopneumonia and bronchitis.

Elting and Martin[48] believe that fat embolism accounts for a number of deaths for which the assigned cause is "shock, toxemia, infection, or concussion," and that fatal cases are particularly prone to occur in connection with fractures of the long bones, especially the femora. They see in the tendency to patency of the blood vessels of the bone marrow and Haversian canals the predisposing cause, and in hemorrhage, edema, inflammation, manipulation, and tight bandaging the exciting cause, i.e., the pressure which dislodges the fat and forces it into circulation. These authors extracted the fat from weighed portions of the lungs and spleen in 2 fatal cases of fat embolism proved at autopsy and compared the fat content with that of the lungs and spleen taken from patients dying from other causes. They found the fat content markedly increased in the cases of fat embolism, of the order of three or more times as great as the normal value.

Accumulation of fat in the capillaries may be sufficiently rapid to give rise to symptoms very soon after operation or trauma, or the process may be more slow, and symptoms may not arise for several days.

In fatal cases the symptoms described have been not dissimilar to those found in cases of shock. (1) There is an increase of temperature, pulse, and respiration rate, (2) early restlessness develops into a condition of delirium, coma, and finally death.

In all cases, the fat emboli, being derived from the systemic circulation, are first carried to the right side of the heart. If the amount of fat be great, it has been supposed that it may here act like an air embolus and embarrass the atrium (auricle) in its efforts to empty itself, thereby causing death in the severest cases.

If the heart be successful in passing the fat out of its chambers, as it usually is, the fat may find its way directly into the coronary circulation and produce multiple small cardiac infarcts; it is believed that most of the cardiac symptoms are produced in this manner. Most of the fat, however, passes directly into the pulmonary circulation and produces edema, congestion, hemorrhage, and rarely infarction of the lung substance.

Such emboli as find their way through the pulmonary circulation may eventually lodge in any of the organs in the body. Lesions have been described in the liver, spleen, kidneys, skin, pancreas, thyroid gland, voluntary muscles, and in fact all of the tissues of the body. Of especial importance is the lodgment of emboli in the brain tissue, since embolism of this tissue may give rise to very dramatic effects depending upon the portion involved.

b. Symptoms and Signs: It is customary for clinical symptoms of fat embolism to develop if at all on the second or third day following extensive fractures of the long bones or extensive operative procedures involving the bone marrow or other tissue rich in fat. Symptoms may occasionally develop much more rapidly or, in other cases, may be delayed for a number of days. According to most observers the earlier the development of symptoms, the more apt is the case to result fatally.

The symptoms and signs depend largely upon the site of the embolic process.

(1) If the heart and lungs be primarily affected the syndrome is primarily "cardiorespiratory."

(a) Symptoms: There is precordial distress accompanied by dyspnea and cough.

(b) Signs: The patient is usually cyanosed, the pulse rapid and irregular, the systolic blood-pressure is low, and there may be hemoptysis. The heart may show dilatation and over the lungs may be heard moist bubbling râles, due to the presence of pulmonary edema; there is usually little or no impair-

ment of pulmonary resonance. The temperature is not much elevated at first but gradually rises to 103°F. or more, and the developement of Cheyne-Stokes respiration occurs terminally.

(2) In the case in which the embolism is chiefly cerebral, the cases present the following signs and symptoms:

(a) At first there occur symptoms which are irritative in type: restlessness, delirium, hallucinations, and drowsiness. Tremors, spasms, or actual convulsions may also occur in this stage.

(b) During the later phases of the irritative stage and characteristically in the terminal stage occur stupor and coma; paralysis and death close the scene.

The Cheyne-Stokes type of respiration may be due to embolism of the respiratory center, and embolism of the temperature regulating center may explain the changes in temperature which are characteristically seen; embolism of the vasomotor center may explain the symptoms of shock.

The clinical course of patients suffering from fat embolism may be either rapid or slow. Certain cases show a fulminating course, apoplectiform in type, and death may ensue in a very few hours. Others persist for days or weeks and may or may not eventually recover. As previously stated, the longer the patient lives the better the prognosis becomes.

c. Treatment: Once a case of fat embolism has developed there is little that can be done beyond the institution of symptomatic treatment. The fundamental treatment is, of course, prophylactic and consists of gentleness in handling tissues rich in fat during operative procedures and immobilization and subsequent general and local rest of cases with fractures of the long bones. Granting that the prolonged administration of the fat-dissolving general inhalation anesthetics predisposed to the condition, an added indication is presented for limiting the duration of such anesthesia to a minimum. Venesection, intravenous injection of saline solution, and the production of a fistula of the thoracic duct are measures

which have been proposed but seem at the present time to offer very little promise as curative measures.

V. Massive Collapse of the Lung (Massive Atelectasis)

A. Historical: To the Englishman, William Pasteur, is usually given credit for having originally described massive collapse of the lung. In September, 1890,[49] Pasteur reported 15 cases of massive collapse occurring in connection with postdiphtheric paralysis in which, he said, the muscles of ordinary respiration, especially the diaphragm, had become more or less involved. Pasteur saw and studied his first case four years previously, that is, in 1886; in 1888, he saw 5 cases and in 1899, 9 cases.

That massive collapse of the lung was known, however, previous to the classical description of Pasteur there can be no doubt, since at least as early as 1853 Gairdner[50] apparently not only recognized collapse of the lung in adults but offered the explanation that it is caused by (1) the existence of mucus in the bronchi, (2) weakness or inefficiency of the inspiratory power, however caused, and (3) inability to cough and expectorate and thus to remove obstructive mucus. As early as 1878 collapse of the lung had been subjected to experimental investigation by Lichthein,[51] who reported two series of experiments on rabbits, in the first of which he blocked the bronchi by introducing laminaria plugs, and succeeded in producing collapse of the lung, and in the second he not only blocked the bronchi but ligated the vessels to the obstructed pulmonary area, and was not in this case able to produce collapse because, as he explained, absorption of alveolar air must be effected by the circulation in order for collapse to occur, no absorption taking place in those cases in which the circulation is interrupted.

Pasteur deserves credit, however, for having given the classical clinical description of collapse of the lung, for having emphasized the importance of the condition, and for having predicted the occurrence of postoperative collapse long before

clinical cases had been reported. Pasteur made this latter prediction in his Bradshaw lecture in 1908,[52] and in 1914[53] he was able to report 16 cases of postoperative massive collapse collected from a series of 201 cases of postoperative pulmonary complications. In the same year, 1914, Elliott and Dingley[54] reported 11 cases of postoperative collapse. Scrimger,[55] in 1921, was the first American author to report postoperative massive collapse of the lung; he reported 7 cases occurring in a series of 540 consecutive operations and extending over a period of one year. Scott,[56] in 1925, in a complete review was able to collect only 64 cases from the literature. Since 1925 much has been written and many more cases have been reported.

Since 1925 there has been a constantly increasing suspicion, amounting to a conviction amongst a considerable number of investigators, that collapse of the lung of one degree or another is responsible for a high percentage of all postoperative pulmonary complications. According to this conception massive collapse is but an exaggerated form of a less serious, because less extensive, and much more frequent complication, viz., "atelectasis." Mastics, Spittler, and McNamee,[22] in 1917, voiced the belief that 70 per cent of all pulmonary complications are comprised by atelectases, and reported 50 cases which they classified as "fulminant," "moderate," "mild," and "evanescent"; they reported 13 cases of the first variety, 17 of the second, 15 of the third, and 5 of the fourth.

Atelectasis, following the suggestion of Jackson and Lee,[57] may be reserved for those cases in which a deflation of lung tissue, but not of the bronchi, occurs in a previously well aerated lung, and this condition may affect the entire lung or any smaller part of it. "Collapse" is in this case reserved for those cases in which not only the alveolar tissue itself but also the bronchi are collapsed.

Both atelectasis and collapse have been encountered following all kinds of abdominal operations and following the

induction of all kinds of anesthesia, including local and spinal analgesias; the condition is found following gunshot wounds of the abdomen, chest, and thighs, in connection with fractures

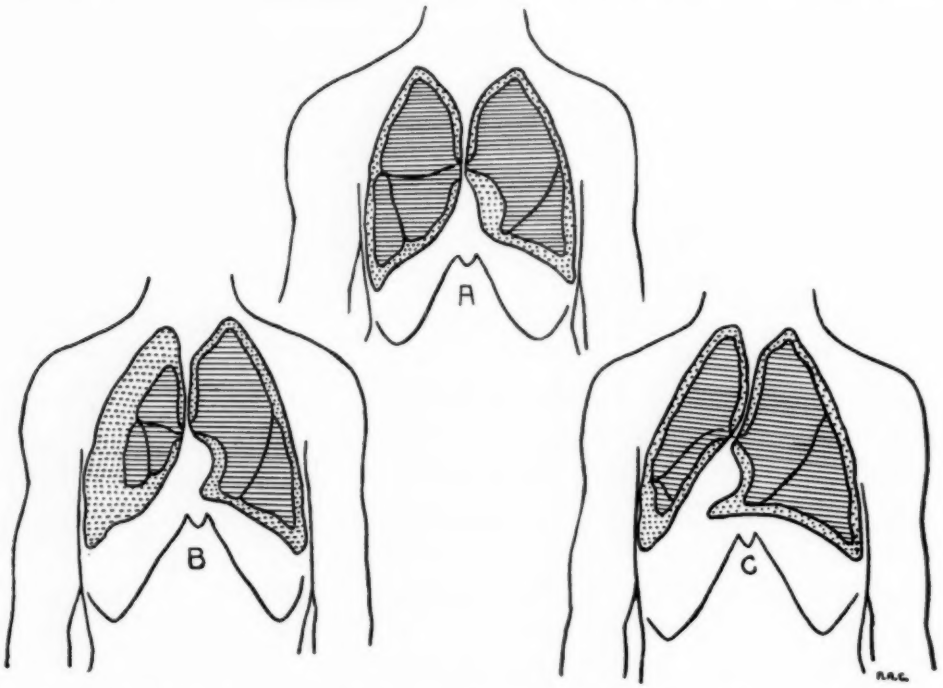

FIG. 50. Effect of pressure relationships in active and passive collapse of the lungs. At "A" is represented normal relationships of lungs, pleurae, and mediastinum. In "B" passive collapse of right lung has been produced by introducing air into right pleural cavity; right lung has become partly deflated by contraction of its intrinsic elastic tissue fibers, and right pleural space has been converted from a potential to a real cavity. In absence of fixation of mediastinum in such a case this structure tends to be displaced slightly to the opposite side, i.e., in this case to the left. In "C" active collapse of lower lobe of right lung is shown; right pleural cavity being still only a potential cavity and containing no air, mediastinum tends to shift to right, and a condition of compensatory emphysema in opposite lung occurs. It can readily be seen that artificial pneumothorax in this case would tend to restore normal pressure relationships and thus restore mediastinum to normal position.

of the femur and pelvis, and also in connection with non-penetrating traumata to the chest.

B. THE MECHANICS OF PULMONARY COLLAPSE: Massive collapse of the lungs is essentially different from the collapse which occurs as a result of the production of pleural effusion or pneumothorax. The latter represents a process in which

intrapleural and intrapulmonic pressures are either partly or completely equalized; and collapse occurs by virtue of the inherent elasticity of the pulmonary tissues, especially the so-called "elastic" fibers. Such collapse may be designated as "passive" collapse.

Massive collapse, on the other hand, represents a condition in which the lung substance loses its air and contracts in the absence of initiating changes in intrathoracic, intrapleural, or intratracheal pressures; it represents "active" collapse, and when definitely established alters pressure relationships in the direction of still further increasing rather than relieving intrapleural negative pressure (Fig. 50). The term "collapse" has been criticized as implying that complete airlessness of the affected area occurs; this latter rarely or never happens, inasmuch as the bronchi characteristically remain patulent. "Atelectasis," however, is a less desirable term, since etymologically it means "failure of expansion," which condition is the reverse of the condition under discussion. "Apneumatosis" is more desirable as a descriptive term than "atelectasis," but seems to have little advantage over the original "collapse," while at the same time being much less expressive.

c. Etiology: Several theories have been proposed to account for the production of massive collapse of the lung:

1. *Paralytic Theory:* This theory was originally advocated by Pasteur. It assumes that collapse is secondary merely to paralysis of the muscles of respiration, especially the diaphragm. This theory is probably untenable in its original form, since it is well known that paralysis of the diaphragm, produced either experimentally or surgically by section of both of the phrenic nerves, does not characteristically result in collapse.

2. *Obstructive Theory:* This theory is championed by Chevalier Jackson and his followers, Lee, Clerf, Tucker, and others. It assumes that the essential feature in collapse is the blocking of bronchi by masses of thick, tenacious secretion, and is, therefore, essentially a foreign-body atelectasis, such as has been known and recognized for many years. This theory

is interesting, but unfortunately does not seem to correspond with the facts in certain cases. Only a very few cases have been reported in which bronchoscopic examination has revealed the presence of such plugs in clinical patients, although it has been shown that the experimental introduction of such material into the bronchi of experimental animals is capable of producing the clinical and radiological picture of massive collapse.

3. *Combined Obstruction and Impaired Respiratory Force Theory:* This theory was originally proposed by Elliott and Dingley, and has since been championed by Churchill and others.

4. *Postural Theory:* Briscoe believed that prolonged quiet breathing in the supine position was capable of producing atelectasis, but fails to elucidate the mechanism of production further than this.

5. *Vasomotor Theory:* This theory, championed by Gwyn and Scott and Joelson, cannot be conveniently separated from the

6. *Angioneurotic Theory*, and both are at best somewhat nebulous. According to Scott and Joelson, the fundamental factor is a pulmonary reflex, probably vasomotor, which causes a partial bilateral obstruction in the peripheral respiratory passages. Superimposed upon this are the factors of the patient's position in bed and the secretion of tenacious material which makes the obstruction complete, characteristically on the dependent side. Air is then rapidly (in a few hours) absorbed from the affected lung, whereas a similar process is prevented from occurring in the opposite one by compensatory hyperventilation.

7. *Reflex Spasm of the Bronchioles Theory:* Since massive collapse does not occur in connection with asthma, in which reflex spasm of the bronchioles is presumably an outstanding phenomenon, this theory has little to recommend it.

D. SYMPTOMS AND SIGNS: The symptoms and signs of collapse depend very largely upon the amount of lung tissue

involved, and they may appear either (a) with some suddenness or (b) may progressively develop during a period of hours. Any part of either lung may be involved in the process, but the right lung is more frequently involved than the left, most frequently the posterior portion of the right lower lobe. Involvement of the middle lobe of the right lung, together with the lower lobe, is next in frequency, then the lower left lobe, the upper right lobe, and the upper left lobe, in the order named.

(1) The severe case with sudden onset presents no particular diagnostic difficulties. It develops as a so-called "collapse attack." Usually within one to four days and most frequently within forty-eight hours after operation or trauma there develops pain in the chest, dyspnea, rapid pulse, and occasionally even cyanosis. The temperature usually is normal at first, but within a few hours becomes elevated to 102.5° to 103°F. and assumes an irregular character. Profuse diaphoresis ensues, and the cheeks usually present a brick-red discoloration as described by Soltau.[58] The posture of the patient is of diagnostic significance; he lies on the affected side with the dorsal spine bent and the head inclined to the affected side. Cough develops within a few hours, and a small amount of sputum, which is usually mucopurulent and never bloody or of the "prune juice" variety, may be expectorated. The leucocyte count early becomes somewhat elevated, and advances steadily to as high as 20,000 cells per cubic millimeter. On inspection the affected side appears smaller than the unaffected side, the intercostal spaces being diminished in width, and a marked respiratory lag is noted on the affected side. Tracheal displacement to the affected side may be found, especially when the site of the atelectasis is the upper right lobe. There is an apparent bulging and exaggerated respiratory excursion on the sound side which is explained by Osler[59] as due to a compensatory or vicarious emphysema.

The cardiac impulse is displaced to the affected side, this naturally being most noticeable in right-sided atelectasis; the

displacement may be obliquely upward and to the right in those cases in which the upper lobe of the right lung, either alone or in combination with the other lobes, is affected. The area of cardiac dullness may be obscured, however, by compensatory emphysema.

Impaired resonance, dullness, or flatness is present on percussion, vocal and tactile fremitus is early diminished, and the breath sounds are suppressed or absent over the affected area on auscultation. No râles are heard. This condition has been called "dead lung." Later in the course of the atelectasis increase in vocal and tactile fremitus with bronchophony and pectoriloquy may occur, together with the development of coarse bronchial râles and mucopurulent expectoration.

Complete disappearance of all signs usually occurs in from three to four days, but signs may disappear in the course of a few hours, with profuse expectoration of mucopurulent material, or they may clear slowly, during a period of one to two weeks during which time the symptoms and signs gradually abate. A certain number of cases develop a superimposed purulent bronchitis or bronchopneumonia, the onset of which is heralded by an exacerbation of the symptoms; râles appear over the affected area, and a blood-tinged expectoration ensues. Such cases may terminate fatally.

The roentgenological picture shows the dorsal vertebrae curved, with the concavity toward the affected side, the ribs converging on the affected side and diverging on the sound side, the heart and mediastinum are displaced toward the affected side, the dome of the diaphragm on the affected side is elevated and relatively immobile, and the lung fields show increased density on the affected side and decreased density on the sound side, changes which may be little or greatly apparent, according to the severity and extent of the atelectasis.

At autopsy the involved portion of the lung is blue or violet in color and sharply demarcated from the normal lung tissue. It is soft, tough, and wet; it feels heavy, does not

crepitate, and sinks when placed in water. Microscopically, the alveolar surfaces are closely approximated, the alveolar spaces being obliterated.[60]

(2) In certain cases there are no localizing signs referable to the chest. There is no pulmonary pain, little or no respiratory embarrassment, or elevation in the pulse rate. Cough, fever, and leucocytosis, which may develop, as in the first variety of case, are often discounted and at other times are correctly evaluated only incidentally as the result of routine chest examination or accidentally as the result of radiographic study.

E. TREATMENT: In the absence of a definite and clear understanding of the mechanism of production, the treatment of massive collapse of the lung is of necessity symptomatic and relatively unsatisfactory. The condition very rarely gives cause for alarm, and apparently always tends to undergo spontaneous resolution in from one to four weeks in the absence of all treatment. For this reason Rose Bradford says that "no special treatment is indicated beyond encouraging, so far as the condition of the patient allows, the free movement of the chest in inspiration,"[61] Sante,[62] however, has found that rolling the patient on the affected side and slapping the affected area, much as is done in attempting to bring about expansion of the lung in the newborn child, is of value, and occasionally results in the expulsion of tenacious secretion and the reinflation of the collapsed lung, as seen under direct roentgenoscopic examination.

Chevalier Jackson and his school believe that patients exhibiting collapse of the lung should be subjected to bronchoscopic examination in the hope of being able to remove obstructing plugs of secretion and thereby bring about a prompt radical cure of the condition. However, Jackson, himself, warns the surgeon against bronchoscopy at the hands of the inexpert operator since irreparable damage may be done by the bronchoscope when unskilfully handled.

Wilson[63] first suggested relief of the condition by the production of artificial pneumothorax, and Farris subsequently

reported 2 cases symptomatically relieved by this procedure. As previously stated, massive collapse represents a condition of local collapse in which the intrapleural pressure is actually decreased. Wilson, Farris, and later, Habliston, have shown that, whereas the normal intrapleural pressure varies between about 2.5 and 6 mm. of mercury (negative pressure), in cases of massive collapse pressures from −12 to 15 or even −25 to −32 mm. of mercury are occasionally encountered. It is believed by this school that the occurrence of the decrease of intrapleural pressure which accounts for the displacement of heart and trachea toward the affected side is not directly responsible for the symptoms. The latter arise, on the other hand, adventitiously, mainly as a result of cardiac displacement and resultant circulatory embarrassment. Reasoning from these premises, we find that the resumption of normal mechanical relationships of the heart and great vessels is the important desideratum. Because, however, of the fact that the condition rarely or never results fatally but, on the other hand, tends in all cases to undergo spontaneous resolution, such a radical procedure as the production of artificial pneumothorax would certainly seem ill-advised except under the most exceptional circumstances.

VI. The Importance of Prophylaxis in Pulmonary Complications

Because of the relative frequency with which postoperative pulmonary complications occur and also because of the unsatisfactory character of the active treatment which at present can be applied to combat these complications after they have developed, considerable attention has been devoted by many investigators to the matter of prophylaxis. Although some consideration has already been given to this subject in discussing the various complications separately, a final word should be added with respect to the general importance of prophylaxis in pulmonary complications.

There can be no doubt that *pulmonary infections* are in most cases secondary to infections in the upper respiratory tract whether the mechanism of production be considered one of aspiration, embolism, or some other process. Of chief importance, therefore, in the prophylaxis of infectious pulmonary complications is the avoidance of elective operations on patients who show evidences of recent upper respiratory tract infections. In a series of cases studied by Whipple a morbidity of 15 per cent was found in patients who just previous to, or at the time of operation, presented evidence of a cold, whereas the general morbidity rate for all cases was 2 per cent or less.[64] Similarly Smith and Morton[65] found that 17 patients of a series of 28 cases who developed postoperative pneumonia gave a history of some respiratory tract infection at the time of operation, usually a common cold, and that in this group the complication characteristically developed promptly or at least within a day or two of operation and accounted for 7 of 22 deaths in the series attributed to postoperative pneumonia.

Because of the especial danger from postoperative pulmonary complications associated with laparotomy incisions in the upper abdomen particular care should be taken not only to avoid performing upper abdominal operations on patients who already show signs of respiratory infection, but also to avoid operating upon such patients during an epidemic of respiratory infection. It is a wise precaution to keep such patients under observation in the hospital for several days prior to operation in case they have recently been exposed to cold or dampness or to contact infection from other members of the family or other persons suffering from respiratory infections, in order that operation during the incubation period of such an infection may also be avoided.

When confronted with surgical emergencies patients presenting a history of recent or concurrent respiratory infections should be given the benefit of the most skilfully induced and maintained anesthesia available, providing general anes-

thesia is considered desirable, and in cases suitable for local or regional analgesia these methods should be given preference even though the advantage gained thereby is possibly not very great. With reference to the part played by the anesthetic in the development of pulmonary complications it should be remembered that lesions secondary to embolic processes can develop following one type of anesthesia as well as another, i.e., following local analgesia as well as general inhalation anesthesia, and embolic cases may follow crushing wounds and compound fractures in which no anesthetic at all has been used. Very few cases, however, which can properly be classed as inhalation pneumonia follow local analgesia.

The advantage of the Trendelenburg position when operating under general anesthesia should be recognized and heeded whenever possible; the advantage of such a position even when operating through lower abdominal incisions has been shown by Terry.[66]

In patients not presenting frank upper respiration tract infections it is very widely believed that pulmonary infections become established only infrequently in cases in which the normal external respiratory movements are maintained, and that the essence of prophylaxis is the maintenance of unaltered pulmonary ventilation. Proceeding on this assumption it has been suggested that pulmonary complications may be attacked prophylactically from two points of view: (1) measures may be taken to determine which patients and which operative procedures present predispositions to such infections in order that one may know which patients require energetic prophylactic treatment, and (2) especially in those cases in which operative procedures tend to limit respiratory movements, measures may be taken both preoperatively and postoperatively to encourage undiminished ventilation or even hyperventilation.

As a measure of the degree of depth of respiratory movements the so-called "vital capacity" of the lungs has customarily been used. Vital capacity consists of the volume

of the greatest possible expiration immediately following the deepest possible inspiration. A certain amount of air remains in the lungs even after the most complete expiration, and this is known as the "residual air"; consequently the vital capacity of the lungs does not represent the entire air content of the lungs during full inspiration.

Briscoe[67] and more recently one of his pupils, Livingstone,[68] have shown that the vital capacity of the lungs is very markedly reduced simply by assuming a supine position; apparently therefore the mere assumption of the recumbent position favors the development of pulmonary complications.

In order to determine the degree of interference with the respiratory function caused by various operative procedures Head[69] measured the preoperative vital capacity of 26 patients who were about to undergo various operations and compared these values with measurements of vital capacity performed on succeeding postoperative days. From the results of these measurements he was able to conclude that operations on the stomach and in general all operations involving incisions into the epigastric angle were followed by maximal reductions which were of the order of magnitude of 78 to 88 per cent. Complete return to normal values had not occurred at the time of dismissal of patients from the hospital, or within a period of eighteen days in one instance. Operative procedures in the lower abdomen caused diminution of the vital capacity, but to a lesser extent, and the period of postoperative return to a normal level was also found to be shorter. Operations on the chest wall itself produced still less significant reductions in the vital capacity, and these reductions were also of shorter duration. Other operations like hemorrhoidectomy and various surgical manipulations on the testis caused only minimal and short-lived effects.

Similarly Powers[70] found that all abdominal operations decreased the vital capacity, but that the upper abdominal operations decreased the vital capacity maximally, and *per contra* that certain other operations, particularly operations

on the extremities and rectal operations, did not limit respiratory activity at all, or at least imperceptibly; the operation of thyroidectomy alone of neck operations was found to limit respiratory movements.

The most recent investigative work on the limitation of respiration caused by abdominal incisions is that of Patey[71] who has shown by measurement of inspired and expired air, by skiagraphic examination of the diaphragm, and by tracings of intra-abdominal pressure variations that considerable interference with the normal respiratory mechanism occurs. This manifests itself particularly as a deficiency of expansion of the lung bases and an associated local venous stasis.

The most reasonable explanation for such findings is that the decrease in respiratory function is secondary to reflex inhibition of the activity of the respiratory muscles due to pain. The diaphragm when it descends depresses the abdominal viscera into the abdomen and in so doing raises the intra-abdominal tension; any increase in intra-abdominal pressure results in immediate tension on any suture-line which may be present in the abdominal wall and in the sensation of pain. In those cases in which the costal angle has been encroached upon by an incision the mechanics of the production of pain are even more direct, since the inspiratory elevation of the ribs exerts immediate traction on such an incision.

As a result of these findings various therapeutic measures have been advocated as of value in establishing and maintaining normal aeration of the lungs postoperatively in laparotomy patients. Amongst the most important of these are:

(1) The avoidance of postoperative distension,

(2) The use of morphine to control pain,

(3) The institution of abdominal massage,

(4) The administration of carbon dioxide or oxygen in an attempt to enforce pulmonary expansion,

(5) The adoption of systematic breathing exercises, and

(6) Postural therapy.

With respect to avoidance of postoperative distension and institution of abdominal massage little need be said. Abdominal distension should, of course, be minimized for other reasons than this and is universally regarded as undesirable. Abdominal massage cannot either adequately or comfortably be performed in the earliest postoperative period, and accordingly is probably a measure of little practical value.

With regard to the use of morphine, it should be remembered that although morphine does, of course, relieve pain and therefore tends to eliminate reflex curtailment of respiratory movements secondary thereto, it has, nevertheless, a direct sedative action on the respiratory center and from this point of view has obvious disadvantages. All in all, any indirect salutary effect this drug may have is probably counterbalanced by its direct sedative action.

Oxygen therapy has, of course, been used rather widely in the active treatment of postoperative pneumonia. Binger, Judd, Moore, and Wilder,[72] Boothby and Haines,[73] and Passalacqua and Judd[74] have emphasized the value of oxygen in the treatment of postoperative pneumonia. They have found the course of the disease remarkably and favorably influenced by the use of this agent. In from eight to eighteen hours the temperature of the patients was found to return to normal, and although it rose again in from twenty-four to thirty-hours it terminated by crisis at the end of a forty-eight-hour period. The general clinical improvement of the patients was also found to be satisfactory; when receiving the oxygen the patients were more comfortable, phlegm loosened sooner, expectoration was easier, and physical changes in the lungs subsided in from four to five days.

Oxygen administration has also been used prophylactically with some apparent success by Passalacqua and Judd.[74] These observers have not only caused patients to breathe oxygen for a period of time before being removed from the operating table, a procedure which might very evidently be of value in producing hyperventilation of the lungs, but

apparently with the idea in mind that oxygen is of prophylactic value *per se* have injected the gas subcutaneously in the axillae in a few cases. From 200 to 400 c.c. were administered in this way, and absorption is reported to have occurred at the rate of 20 c.c. per minute. This latter procedure can hardly be accepted enthusiastically in the absence of more convincing evidence as to its value.

Carbon dioxide is administered by inhalation. The procedure in most common use is the immediate postoperative administration of a combination of carbon dioxide and oxygen before the patient leaves the operating table.

The therapeutic uses of carbon dioxide administration by inhalation has been appreciated generally only since 1920. Henderson and Hagard[75,76] in that year first described the value of the method in facilitating elimination of carbon monoxide from the blood through the lungs. That the practical application of the hormone-like action of carbon dioxide on the respiratory center was not made earlier is remarkable, particularly in view of the unusual esteem in which the drug has come to be held in the few subsequent years.

Under ordinary conditions an adult individual consumes about 7 l. of air per minute. The concentration of carbon dioxide in ordinary atmospheric air is about 0.04 per cent. If the concentration of carbon dioxide be increased artificially to 5 per cent the volume of inspired air begins to increase almost immediately and within about twenty seconds 30 l. of gas are being inspired each minute. The increase of respiratory volume when analyzed is found to be secondary to increases in both rate and depth of respiratory movements, and the effect continues as long as the composition of the inspired air remains unchanged.

For therapeutic administration carbon dioxide mixtures containing more than 10 per cent of the gas are rarely given, not only because higher concentrations serve no useful purpose, but also because of the danger of overdosage; when patients are given this substance in too concentrated form they develop

pallor, rapid and irregular respiration, and fibrillary twitchings of the muscles of the face, carbon dioxide acidosis.

Carbon dioxide inhalations have found a field of usefulness in the treatment of a variety of conditions, such as carbon monoxide and illuminating gas poisoning, alcholic intoxication, asphyxia neonatorum, persistent singultus, postoperative empyema, trauma to the respiratory center, morphine poisoning and uremia. Their value in the treatment of these rather varied conditions depends (1) upon increased expansion, i.e., hyperventilation of the lung as such, (2) upon removal of harmful volatile substances from the blood as a secondary process, (3) upon an associated action on the muscles of respiration, especially the diaphragm, or (4) upon a combination of these processes.

In the prophylactic treatment of pulmonary complications advantage is taken of these actions as follows: (1) the duration of anesthesia in the use of the common inhalation anesthetics can be considerably shortened, and (2) thorough expansion of the lungs, especially at the bases, may be induced as frequently as may be desired.

Henderson, Haggard, and Coburn,[77] in 1921, pointed out the ease with which patients could be de-etherized postoperatively by carbon dioxide inhalations, and, in 1923, White[78] reported a series of 41 clinical cases so de-etherized using a mixture of about 5 per cent carbon dioxide in atmospheric air. White's patients experienced a return of consciousness which was from three to five times as rapid as that experienced by a control group of cases, and incidentally there was thought to be less postoperative nausea and vomiting in the treated series than in the untreated ones.

The value of de-etherization is believed to be confined mainly at least to the earlier period of recovery from the effects of the anesthetic for two reasons. (1) In accordance with the physical laws of the diffusion of gases from liquids, the greatest amount of anesthetic gas is liberated from the blood almost immediately, and the rate of diffusion thereafter progressively

decreases, until after a relatively short period of time very little gas is liberated per unit interval of time; inasmuch as the amount of gas eliminated latterly is minimal the time required for complete elimination is proportionally long; the net result is that although hyperventilation appreciably shortens the period of rapid elimination of an inhaled gas, the effect becomes progressively less and less apparent as time goes on. (2) As patients regain consciousness they characteristically become unmanageable under this form of therapy and violently resist attempts on the part of the anesthetist to continue the use of the method. Practically it has been found that carbon dioxide inhalations have ceased to serve any very apparent useful function after about twenty to thirty minutes. This amount of time, however, cannot well be spared under ordinary hospital conditions unless it can be shown that patients receive very definite benefits thereby, and accordingly it is customary to confine the use of carbon dioxide to a minimum time interval, viz., about five minutes.

Nitrous oxide and ethylene gases are much more volatile than ether vapor, and for this reason are eliminated with much greater rapidity. This consideration together with the fact that modern machines designed for the administration of nitrous oxide and ethylene are usually provided with accessory facilities for the administration of nitrous oxide oxygen mixtures makes denarcotization particularly easy and satisfactory in the use of the more diffusible gases. Thus Lundy[79] in a recent résumé of the use of carbon dioxide at the Mayo Clinic reports favorably on the use of carbon dioxide postoperatively during the five or more minutes during which the patient is on the operating table after the operative seance itself has been brought to a close and while dressings are being applied; in this short period of time he thinks enough hyperpnea can conveniently be induced to eliminate most of the anesthetic, if it be ether, and almost all of it if it be nitrous oxide or ethylene.

When carbon dioxide is used for purpose of de-etherization some sort of expiratory valve must, of course, be incorporated

in the inhaler employed, otherwise the anesthetic vapor will simply be rebreathed.

Churchill[80] apparently first called attention to the value of carbon dioxide in the expansion of atelectatic pulmonary tissue in connection with reexpansion of the lungs following thoracotomy for empyema.

Sufficient attention has already been paid to a consideration of the etiological relationship between hypoventilation, atelectasis and pulmonary infection to emphasize the value of carbon dioxide inhalations or any other agent or method which tends to maintain normal or exaggerated expansion of the lungs. That administration of carbon dioxide performs this function most efficiently is hardly open to question and ultimately, therefore, the question of the prophylactic use or nonuse of the method becomes a matter of expediency. Some surgeons use the method more or less routinely and habitually keep on their wards one or more apparatuses for the inhalation of suitable carbon dioxide mixtures. When given as a matter of routine, the apparatus is wheeled to the bed of each patient several times during each twenty-four hours and enough gas mixture (usually 90 per cent oxygen and 10 per cent carbon dioxide) is given to stimulate hyperpnea for a period of a minute or two. All patients who are observed to be of poor color or to be breathing shallowly are subjected to the treatment at much more frequent intervals.

A rather simple and probably efficient method of prophylaxis of pulmonary complications is the encouragement of systematic deep breathing exercises. This is a procedure which requires no accessory equipment and no financial expense. It is undoubtedly not so efficient as carbon dioxide in expanding the lungs, partly at least because it is incapable of completely overcoming splinting of the respiratory muscles due to pain, but it is an almost universally applicable method. It is dependent for success upon cooperation between surgeon, attendants, and patient, and will succeed maximally only in those cases in which patients are intelligent and are intelli-

gently managed. The nursing staff can do much to aid in the proper administration of the method by being patient and encouraging. A five minute period of active effort in deep breathing should be required of laparotomy patients every hour for the first three or four postoperative days, if the method is to succeed, and the effort should be carried to the point of producing actual pain. These exercises should be begun just as early postoperatively as the cooperation of the patient can be enlisted, and a spirit of congenial rivalry can rather easily be fostered among patients in wards in the continuation of the process.

The importance of posture is probably not sufficiently realized. Not only does prolonged maintenance of the same local position favor gravitation of fluids to dependent portions of the lungs and thus tend to produce compression of lung substance, but these organs receive a certain amount of pressure directly through the bony thorax from the bed, and also from the weight of superimposed tissue, the heart, and the opposite lung. Frequent changes in the position of the patient tend to avoid prolonged compression of any particular part of the lungs and thus to minimize the formation of foci of lowered resistance. Furthermore it is not sufficiently appreciated that the mere assumption of the recumbent position causes areas of increased density to appear in the bases of the normal lung. In this connection Boland and Sheret have suggested elevating the foot of the bed 20 in. and removing pillows from under the head. In 47 patients thus treated in whom careful skiagraphic examinations were made all showed excellent aeration at the bases while the body remained inclined, although mottling occurred in certain cases when patients were lowered to the horizontal position.[81]

VII. The Value of Roentgenograms in the Diagnosis of Pulmonary Complications

In view of the veritable flood of both clinical and experimental reports on postoperative pulmonary complications

which have appeared within recent years a word or two of warning may be spoken on the fallacy of interpreting too closely the skiagraphic findings in films of the lung fields. Muller, Overholt, and Pendergrass[82] have recently emphasized the fact which, to be sure, has been more or less clearly appreciated by many other investigators, that positive roentgenographic findings are by no means always associated with commensurate clinical reactions. The discovery, therefore, of areas of radiopacity especially at the bases of the lungs, haziness of the lung fields, and elevation of the diaphragm when discovered accidentally or when occurring in the absence of definite symptoms and signs must not be interpreted as necessarily abnormal. For the most part these findings represent the normal postoperative pulmonary picture; the expansion of the lung is very seriously curtailed, the diaphragm fails to descend properly, and areas of patchy atelectasis develop in the more dependent portions of the lung fields. If this fact be not borne in mind the surgeon can find "silent" pulmonary complications in most of his laparotomy cases merely by invoking the aid of the roentgenogram.

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